BOTANICAL TRACTS,

By Dr. *HILL*,

VIZ.

1. Usefulness of a Knowledge of Plants.
2. Outlines of a System of Vegetable Generation.
3. The Origin of Double Flowers.
4. The Origin of Proliferous Flowers.
5. The Sleep of Plants.
6. The History and Virtues of Valerian.
7. An Account of the Mushroom Stone.

To which are added

1. The Method of Propagating Trees by their Parts, by Mr. *T. Barnes*, a Correspondent,
2. The Practice of Gardening, by Mr. *T. Perfect*, a Pupil of Dr. *Hill*.

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THE USEFULNESS OF A KNOWLEDGE of PLANTS:

ILLUSTRATED

In various Inſtances, relating to MEDICINE, HUSBANDRY, ARTS, and COMMERCE.

WITH

The eaſy MEANS of INFORMATION.

By *J. HILL*, M. D.

LONDON:

Printed for R. BALDWIN, in *Pater-noſter-row*; and J. JACKSON, in *St. James's-Street.*

M.DCC.LIX.

THE USEFULNESS OF A KNOWLEDGE of PLANTS.

INTRODUCTION.

THE frivolous purſuits in which ſome have engaged, under the name of Enquiries into NATURAL KNOWLEDGE, and which the incurious world have been content to diſtinguiſh by the ſame title, have brought that uſeful ſcience to diſgrace: The VIRTUOSO has been conſidered as a NATURALIST, and the FLORIST has been honoured with a name derived from BOTANY. If the credit of that ſtudy were

all, it would be eaſy to paſs over this in ſilence; but more than thoſe who love the ſcience are intereſted in the conſequences: it is in many inſtances neceſſary to the convenience, and in ſome to the very being of mankind: the world therefore owes the ſubject more reſpect than to confound it with the amuſements of an idle, though innocent curioſity.

THE knowledge of plants, in particular, is of ſo various and important uſe, that the Publick would perhaps do wiſely to provide there ſhould be always ſome perſons who made it their immediate care. Such a knowledge may be uſeful in a high degree to MEDICINE, to AGRICULTURE, and to ARTS and COMMERCE; for plants are eſſentially concerned in all theſe: and certainly the greater advantages will be obtained in them, the more the objects are underſtood. May I be permitted to add a fourth great article in which this ſtudy has an high utility? a conſideration indeed ſuperior to them all: 'tis PIETY. He who can ſee the wonders of their form, and not adore the hand that made them, deſerves

not

not the character of a rational being; nor does he much leſs degrade himſelf, who ſees them, and is ſilent. In theſe, altho' the humbleſt of his works, we ſee the great Creator clearly and diſtinctly; and while we view their growth, they raiſe the mind to heaven.

So far as MEDICINE depends on plants, a knowledge of them is eſſential equally to its SUCCESS in the preſent practice, and to its ADVANCEMENT by new and uſeful diſcoveries. Who ſhall depend upon the virtues of an herb, a root, or ſeed, when it is impoſſible he ſhould know whether he really takes them? or how ſhall the phyſician judge of their effects, who is not ſure that they were given? yet this uncertainty is too juſtly founded upon the preſent ignorance and inattention of the ſeveral ranks through whoſe hands all preparations muſt paſs between the phyſician's preſcription and the patient. We ſee in ſimple medicines of this kind the abuſe is great; doubtleſs in compounds it is greater: nor is the miſchief confined even within theſe bounds. Tradition tells the mother of a family this herb or that will cure the diſorders of her

children; but ſhe is deceived when ſhe makes the trial; for ſomething elſe is ſold under its name.

ROMAN WORMWOOD will cure indigeſtion; for it is an aromatick, warm, and cordial medicine; but no ſuch herb is brought to market: they ſell SEA WORMWOOD, a nauſeous bitter, in its place, and the true medicine, though poſſeſſed of all its virtues, has thus loſt much credit. All this time there is no plant more hardy than true ROMAN WORMWOOD, none more eaſily propagated in the open ground: but the phyſician overlooks the abuſe; and long neglect has made the other an univerſal ſubſtitute.

MR. DAVIES, on the great ſucceſs of the the BARDANA in the gout, took for three weeks, in vain, a nauſeous infuſion of the root of COMMON BLUNT-LEAV'D DOCK. This had been dug up to ſell under the name of the SHARP-POINTED DOCK, famous in ſcorbutick caſes; and by a ſecond abuſe was palmed upon the purchaſer under this other name.

A few months ſince, the YOUNGER MR. DELAVAL acquainted me he had been

uſing the BLACK BRYONY ROOT externally for a fixed diſorder in his ſide, by the preſcription of DR. JAMES; but without any effect. Enquiring into the ſymptoms which would have neceſſarily appeared upon the application of that medicine, I found he had felt nothing of them; and on producing the root, it appeared he had been all the time uſing the WHITE BRYONY; a plant, though idly called by the ſame generical term, yet altogether different in its virtues.

THE inner bark of the ſmall ſhrub FRANGULA, is a cathartick equal to any of the foreign drugs, and is peculiarly excellent againſt obſtinate cutaneous diſorders. I ordered this to a perſon who had ſuch a complaint; and they ſold him, in its name, the bark of COMMON ALDER, an aſtringent.

TO a poor perſon periſhing under a jaundice, I directed the DULCAMÀRA, a medicine ſuperior to all others in the laſt ſtage of that diſeaſe; and ſhe received inſtead of it the COMMON NIGHTSHADE. This might have been of fatal conſequence; for the doſe of the other is ſo large, that

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an equal quantity of this muſt needs have been deſtructive. Both theſe abuſes roſe from errors of the ſame kind: We call the Frangula, Black Alder; and the Dulcamara, Woody Nightſhade. They were to blame who introduced this corruption of names; but that is too eſtabliſhed to be altered: the care muſt now be to make them underſtood. The knowing plants diſtinctly is the immediate buſineſs of thoſe who keep ſhops for the ſale of them; and the meaneſt ſervant who is allowed to officiate, ſhould be compelled alſo to learn their differences. Theſe are inſtances in which my particular care in ſeeing the plants, ſaved the lives of thoſe who were to have taken them: may we not juſtly think many are loſt where the abuſe is not diſcovered.

TENDERNESS for names prevents my mentioning ſome other inſtances: but they are needleſs, for the abuſe is in a manner univerſal. WHITE MAIDENHAIR has virtues greater than all its kind, but FERN is ſold conſtantly under that name; tho' the plant itſelf is common.

The true wild Valerian, eminently uſeful in nervous diſorders, was no where to be had, before the fraud of ſelling a wrong kind was ſhewn: but now the ſhops are full of it; phyſicians find its original excellence, and the drug has recovered its long-loſt eſtimation.

The roots of the common double-flowered Piony, are ſold for medicinal uſes: whereas the phyſicians direct only thoſe of the ſimple kind, called for diſtinction the Male Piony; and experience ſhews theſe alone have the full virtue. Nay it is not long ſince that in the place of the common Dropwort, an eſculent root, the Hemlock Dropwort was brought to one who wanted it; the moſt fatal of all the Engliſh poiſons.

We ſee ſome plants of little efficacy, and others of different qualities from thoſe intended, are ſold under their ſeveral titles: nay ſometimes ſuch as are deſtructive. Under the name of Bugle, an excellent ſub-aſtringent and balſamick, they ſell Vipers Bugloss, a detergent of more power than

is generally known; for the BLACK HOARHOUND, an anti-hyſterick medicine, they ſell the WHITE HOARHOUND, a pectoral; for LITTLE CELENDINE, uſeful againſt the piles, GREAT CELENDINE, good in diſorders of the eyes; and for the true BLACK HELLEBORE, famous for many virtues, and no harſh medicine, they ſell always the Green-flowered BASTARD HELLEBORE, or the GREAT SETTERWORT; giving to infants, a violent medicine inwardly, whoſe proper uſe is externally for cattle.

BY this fault the ſucceſs of medicine, ſo far as it depends on plants, is rendered precarious; and from the ſame cauſe improvement in that branch is become impoſſible. In England the roots of GOLDEN ROD have been found excellent againſt the gravel; and thoſe of the LONG CYPERUS, a cure for dropſies, in the ſtages wherein that deſperate diſeaſe is curable: but tho' this knowledge comes upon fair authority, how ſhall it be confirmed? He who ſhall attempt to try the virtues of theſe roots, will probably find ſome other thing ſold in their place; and it will be ſuppoſed they

have not the virtue which has been attributed to them, becaufe that root has not the fame which ignorance or fraud has fubftituted in their ftead.

FROM the favages of North America we have heard, that the root of MOUNTAIN AVENS will cure agues, in the manner of the bark; and probably this is true: for the fame virtue has been attributed by many writers to the COMMON AVENS of our hedges. Perhaps it loft this credit unfairly, by fome other root being fold for it: but where is the chance that it now fhould be reftored? From the fame quarter of the world we receive intelligence of a LOBELIA, diftinguifhed by a peculiar quality in the cure of the venereal difeafe; and that the COLLINSONIA, a plant fome years fince received into our Gardens, and named from one who does great honour to this ftudy, poffeffes virtues for the relief of the diforders of pregnant women fuperior to all other remedies.

THESE feveral plants we may raife in any quantities; and there is fair ground

to hope the art of healing may be greatly improved by them: but they muſt firſt be known; and theſe abuſes muſt be removed before 'tis poſſible we ſhould enjoy the benefit. The BARK itſelf came to our knowledge the ſame way; and we want other Medicines of ſuch Power: America may produce them; indeed there appears reaſon to believe it does: but unleſs the knowledge of that part of nature, whence they are obtained, be more regarded, there is little chance of our receiving the full benefit.

IF from medicine we turn our eyes to AGRICULTURE, the proſpect is the ſame: great advantages are in our reach; but if we neglect to underſtand the ſubjects, we ſhall loſe them.

ALL know how lately we are become acquainted in England with what are called the ARTIFICIAL GRASSES, plants raiſed by tillage for the food of Cattle; nor is there any one who diſputes the vaſt advantage our huſbandry has received from them. The number we have of theſe at preſent, tho'

much larger than was known to our forefathers, is yet very limited, and the great benefit wou'd be variety. It will be eafy to add, where fo much has been difcovered; and to apply to Britain what Linnæus has advanced in Sweden.

NATURE has not confined this fource within narrow bounds: it is our ignorance alone which makes it feem fo. We find that even in kingdoms farther north than ours, the peafants have introduced many plants yet unknown to our farmers; and there are wild about our hedges others which might be cultivated to a vaft advantage. The YELLOW MEDICK WITH WREATHED PODS, which grows neglected on our wafte grounds, is the new plant now cultivated fo fuccefsfully in Sweden: the farmers, indeed the whole country, are enriched by it, and the character under which it ftands recorded in their publick acts is *Omnium omnino præftantiffimum pabulum*, ALTOGETHER THE MOST EXCELLENT OF ALL FOOD FOR CATTLE. There is no difputing their teftimony, who have fo much experience, nor is there any reafon

why we ſhould not ſhare the benefit in Britain.

THE KIDNEY VETCH, and LADIES MANTLE, eminent for the nouriſhment they afford; the firſt to ſheep particularly, the other equally to thoſe creatures and to cows; are wild in gravel-pits, and by road ſides: but they are unknown in our paſtures, unleſs by accident, and then unregarded; while they are both ready to grow from ſeed ſcattered among the graſs of hilly and barren cloſes; encreaſing the quantity of food tenfold; and improving it in the ſame proportion.

THE CHICHLING VETCH, which riſes in our damp thickets, is capable of giving the ſame benefit to wet marſhy lands; perhaps even to bogs: but no farmer knows it. Melilot, though not regarded for this purpoſe, wou'd, in the ſame degree, enrich an open paſture; and the BURR REED, of our ditches, might fill the wet moors with food for our horned cattle, for no plant is ſo readily eaten by oxen; nor is there any one more wholeſome.

AMONG the articles uſeful in the arts, and objects of our commerce, it is not conceived what benefit might ariſe from a more perfect knowledge of their nature. Many of the moſt conſiderable are native of our own country; tho' neglected here, and ſought at a large price abroad: and we have others which might ſupply the place of ſome that are imported, perhaps to better purpoſe. To inſtance only among thoſe ſubſervient to dying.

THE French exceed us in their BLACK for cloths: and from many circumſtances there is reaſon to believe, they owe the advantage to a wild plant, as common here as it can be with them; it is the LYCOPUS, or WATER HOARHOUND: it has been early ſaid, tho' now neglected, that this plant yielded a peculiar and diſtinguiſhed black: and ſuch limited experiments as I have had opportunity to make, confirm it. 'Tis certain the French gather this herb carefully, which we ſuffer to periſh uſeleſs; nor is there any other purpoſe known, to which they can apply it.

WE bring Canary weed, a dry brown moſs from that remote country, to uſe in our red colours: but we have rocks and barren hills at home covered with a moſs of like nature; and as it ſhould ſeem of many times its value.

IN Sweden red is dy'd with the roots of SQUINANCY WORT, yellow with the bark of BUCKTHORN and BLACK ALDER; and red with the SAW-WORT as we do yellow with the Saffflower; little unlike the other but in colour. All theſe are weeds, or wild hedge-ſhrubs with us: and why ſhould not every one have a fair trial? Perhaps the Society for the encouragement of Arts and Commerce, the beſt ever inſtituted in our country, may raiſe the ſpirit of this improvement by their premiums: but who ſhall aſſure the induſtrious mechanic that he has the right plants? 'tis ten to one againſt him, whereſoever he attempts to buy them.

THAT the Sick are frequently defrauded of their cure, and perhaps ſometimes deſtroyed by the abuſes of thoſe who deal in herbs, is moſt certain. But how ſhall they who

who ſell them be inſtructed better? or who ſhall ſhew the former what that MEDIC is; or what thoſe other plants he is adviſed to cultivate? Where ſhall the dyer learn what is the true SAW-WORT, or who ſhall tell him the diſtinction between BUCKTHORN and BLACK ALDER; the very berries of which laſt ſhrub, are often ſold for thoſe of the other, even to the apothecaries.

GREAT as the diſadvantages and miſchiefs are which ariſe from the preſent want of information; the remedy is eaſy. Galen preſcribed it in his time, when he ſaw the ſame neceſſity. It is the "teaching thoſe who are concerned; not by "ſlight words, or vague repreſentations, but "by the plants themſelves; raiſed in ſome "ſmall ſpot for that ſingle purpoſe." The learned may ſtudy them in books; but there is none ſo low in mind, who would not know them by the things themſelves, preſented growing to his eye, and explained upon the ſpot before him.

THIS ſpot ſhould be planted with every herb uſeful in medicine, in the arts, or huſbandry; and ſhould be open always, free of

expence;

expence, and to all people: and there ſhould be ſome perſon preſent to ſhew what was deſired to be ſeen, and to explain what was neceſſary to be known.

FROM a ſpot thus planted, and thus calculated for plain utility, ſcience need not be baniſhed; nor indeed ought: becauſe upon its principles alone, are eſtabliſhed thoſe abſolute diſtinctions which prove the error or the fraud of common practice; and which would render all miſtake, and future deception, equally impoſſible.

THE plants raiſed for this ſervice, would appear as conſpicuous to the common eye, when diſpoſed in the regular claſſes of the modern botany, as any other way; and to the ſtudent they would be much more diſtinct, and plain in all their differences. Whatever could be done by a claſſical diſtribution of the ſhrubs and flowers in more extenſive plantations, may be executed even with theſe humbler kinds; and the purpoſes at once of the ſtudent and the publick, fully anſwered.

PLANTS would be known with certainty, from feeing them fo difpofed, and hearing them clearly and ufefully explained. Great care fhould be taken to fhew diftinctly the different kinds which ignorant cuftom, or inconfiderate writers, have called by the fame general name: there fhould be fhewn together, with each plant, what other fpecies were moft like it; and there might be added always in fome near border, the thing ufually fold under its name. This would be fixing the whole fubject upon the memory, even of the unlearned.

THE nature and qualities of plants might here be pointed out in prefence of the objects; and their value fhewn, not only fo far as is known, but in thofe farther advantages which might reafonably be expected from them. The garden would be a kind of living herbal; in which it might be eafy to explain, in a diftinct order, what each plant was, whence it was brought, and how diftinguifhed from all others; what virtues it, poffeffed, and for what fervices it was proper. A leffon too fhort to load the memory; and too regular to be mifunderftood. Thofe who ftudied the nature of

vegetation for the assistance of the arts of culture, might there see a vast variety of plants in every season, subjected to all rational experiments; manures of every kind might be experienced fairly; and the arts, the means, and objects of improvement in our husbandry, all shewn at once. The curious would have the advantage of seeing, in a single view, the various useful products of the several parts of Europe: and even more nice enquiries might be here turned to use: for it is not impossible that in many cases, what one plant does well, another species of the same kind may effect yet better. Why should we suppose that he who, probably by accident, made the discovery of the use of any plant, has always chanced to try the most effectual kind.

A LITTLE spot would answer all these purposes; and such a garden might be supported at small expence. Till that shall be established; the Author of the Proposal will take a pleasure in giving this information to all who want it at his own garden. Let none fear to apply, the plants are there; and every one is welcome.

FINIS.

OUTLINES

OF A

SYSTEM

OF

Vegetable Generation.

By Dr. J. HILL.

Illuſtrated with FIGURES.

LONDON:
Printed for the AUTHOR;
And to be had of R. BALDWIN, in *Pater-noſter-row*;
T. OSBORN, in *Grays-Inn*; G. SEYFFERT, in *Dean-ſtreet*, *Soho*; and R. WATKINS, Optician, at *Charing-Croſs*. M DCC LVIII.

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OUTLINES

OF

Vegetable Generation.

The DESIGN.

THE purpoſe of this work is to attempt, on principles not before eſtabliſhed, and from the conſtruction of parts hitherto overlooked, or too lightly regarded, an explanation of the PRODUCTION OF PLANTS.

SINCE the generation of animals, after ſo many experiments and diſſections, is yet obſcured by many difficulties, we cannot expect ſwift advances in the diſcovery of that of vegetables; in which the parts are ſmaller, their office is leſs known, and their diſſection much more difficult.

No more is attempted here than to lay down the ſketch or firſt deſign of a method, in which this ſubject may, perhaps, be traced ſucceſsfully: outlines which the ingenious are invited to aſſiſt in filling. The courſe of nature is here followed (faithfully, if imperfectly) only in one plant; and what advances are made, have been the reſult of a few months obſervation under a ſingle hand: years, perhaps ages, are required to purſue it thro' the ſeveral orders of the vegetable ſyſtem.

ONE plant alone is examined to avoid perplexity: others will be eaſily ſub-

jected to the like enquiry; and they will either confirm this ſyſtem, or eſtabliſh a better. Truth will be one way or other found.

EVERY diſcovery, however ſmall or imperfect, is an advance in knowledge; and has its Value. One new and juſt obſervation is worth all the ſyſtems that ever were invented. I know how to reverence the FLORENTINE and SWEDE; but I ſhall here regard what no author writes: only what nature offers to the ſight, on due inſpection.

THE Enquiries I have attempted have been made with caution; and I ſhall be content to proceed ſlowly. The ſearch being after truth, all conjecture has been baniſhed, till the principles are known: and the little I may have diſcovered, which is publiſhed as an inducement only to proſecute the ſubject, is laid down in terms plain to the unlearned. The gardiner may do more than

the philoſopher in this point; for he has the means of conſtant obſervation.

THERE are many things in which plants and animals agree; but there are alſo ſeveral in which, for obvious reaſons, they cannot but differ. Analogy, therefore, may be uſeful; but it muſt be purſued with limitations, or it will miſlead.

CHAP.

CHAP. I.

The general Strurture of Vegetable Bodies.

TO underſtand a part of any ſubject well, it is neceſſary to have a juſt idea of the whole. The organs employed by nature in the generation of plants, are the immediate objects of this reſearch: but they cannot be perfectly known till we are acquainted with the reſt of the vegetable conſtruction.

A plant is an orgainized body, endued with a power of growth, and a kind of life; but without ſenſation.

Plants conſiſt of five parts: 1. The outer bark. 2. The rind. 3. A vaſcular ſeries. 4. The fleſhy ſubſtance. 5. The pith.

These are common to all plants, trees and the moſt tender herbs, only differing in

consistence. They are most distinct where they are most firm, as in the woody kinds; and least where they are most tender, as in the thick stalks of bulbous rooted plants. In these the inner parts often resemble spunges filled with water; and are only distinguished by the gradations of colour.

The several organs of generation are formed, by continuation only, from one or other of these parts.

The parts are always arranged in the order here laid down; the bark outermost, and the rest in that regular succession.

The root draws nourishment from the earth; and the stalk conveys it to the flower. In the flower are placed the organs of generation. These are generally understood to consist of the Filaments, with their Antheræ, and the Style with its Stigma, and Rudiment of the fruit: but there

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are other parts equally worthy notice. Theſe not having been ſufficiently obſerved, the ſyſtem of generation has been imperfect.

I propoſe to trace theſe ſeveral parts in a plant, in which they are all large and conſpicuous; tho' the latter have not been before obſerved in it.

THIS plant is a ſpecies of AMARYLLIS; it is diſtinguiſhed from the reſt by the drooping poſition of the FILAMENTS, and is a native of the American iſlands*.

THE root is a bulb: the ſtalk is naked and a foot high. The leaves are graſſy, but of ſome breadth; the flower is compoſed of ſix petals, and has ſo many FILAMENTS with a ſingle STYLE.

THERE is nothing in this plant ſingular or uncommon: the parts are plain and ſimple; therefore they will be eaſily traced:

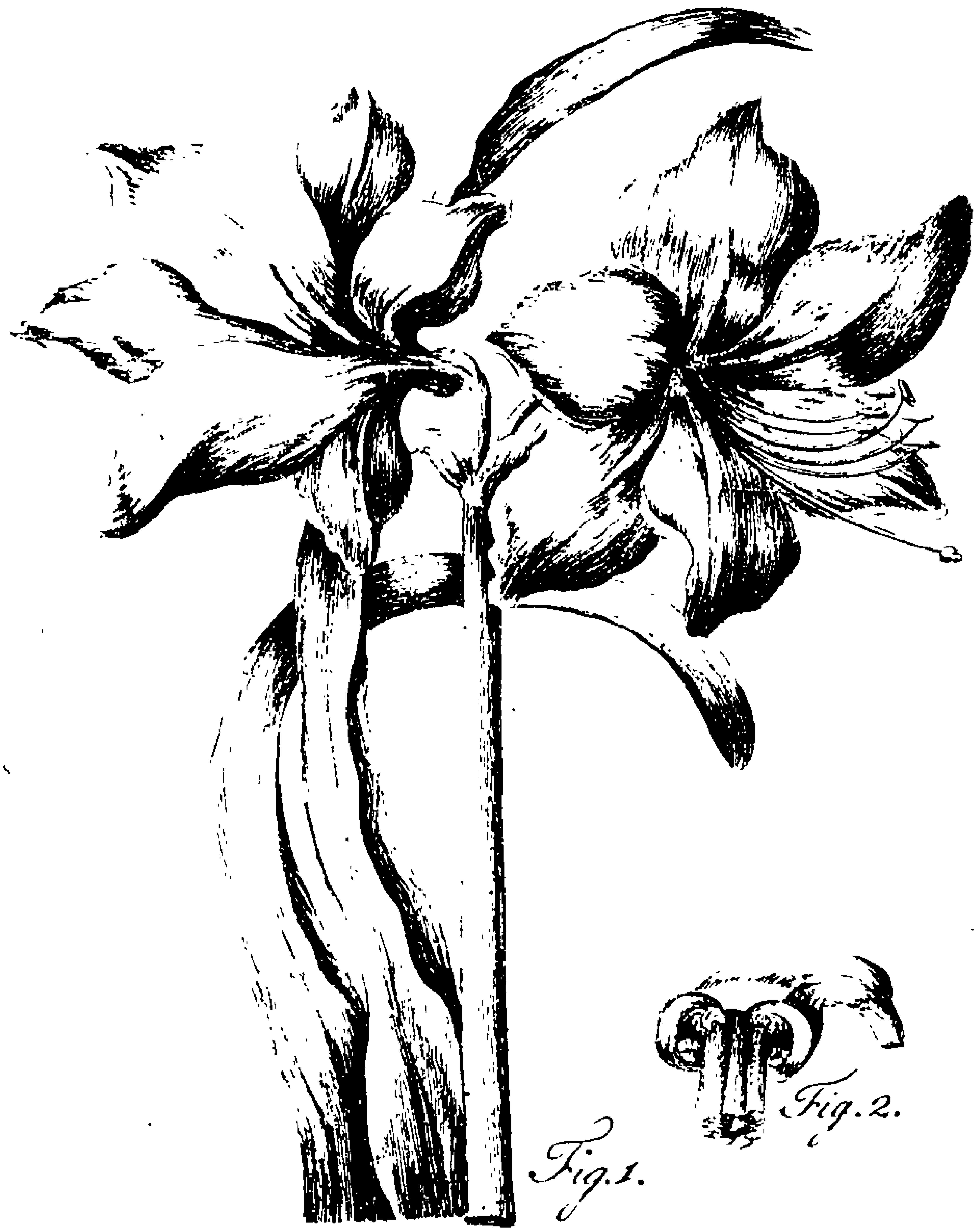
* *Amaryllis Spatha multiflora, corollis campanulatis æqualibus, genitalibus declinatis.* Linn. Sp. 293.

they are very conſpicuous; and they will, probably, be found of the ſame ſtructure in the generality of others. See Pl. I.

The Bulb is the covering and defence of the young plant: its fibres properly are the roots. The coats of the large part are like thoſe films which encloſe the young ſhoot in the buds of trees, and are deſtined only to that purpoſe.

The ſtalk is thick, a little flatted, and hollow: a tranverſe ſegment of it repreſents an elliptic ring, with a large aperture. In this the five diſtinct parts of vegetable conſtruction, before enumerated, may, with due care, be traced: and this beſt of all by maceration and diſſection.

The outer bark is rediſh and filmy: the rind is green and thicker: the vaſcular ſeries is pale: the fleſhy ſubſtance is white: and the pith, which ſurrounds the hollow to



Amaryllis genitalibus declinatis.

J Hill del. et Sculp.

a conſiderable thickneſs, is perfectly cryſtalline, and colourleſs.

THE diviſions of theſe parts are indiſtinctly marked; but they are abſolute. The vaſcular ſeries is whitiſh, the fleſhy ſubſtance white and ſemipellucid, the pith perfectly clear, and altogether colourleſs.

THE bark has many fibres: the four other parts are full of bladders and large veſſels. The bladders are roundiſh, but cruſh'd by preſſing one againſt another: they are ſmalleſt in the rind, and larger all the way to the pith, in the inner part of which they are wideſt of all.

THE veſſels are elliptic, and have large cavities. They are continued in an uninterrupted courſe, from the extreme fibres of the root, to the ſeveral parts wherin they terminate. On this ſtructure depends the courſe of vegetation; which is conducted thus.

THE

THE root being planted in the ground, where there is heat and moiſture, receives nouriſhment; which expanding and enlarging the embryo plant, ſends it up thro' the ſurface. A ſtalk riſes, on whoſe top appears a membranaceous ſcabbard, containing two flowers: this burſts open, they diſcloſe themſelves; and beneath each is the rudiment of a ſeed veſſel, in which are ſhells of ſeeds.

THE plant has now perfected its growth, and muſt ſoon after decay: but nature, rather the God of nature, thus prepares a reſtoration.

THE filmy ſcabbard formed from the outer membrane of the ſtalk, having performed its office, fades. The flowers are hardened for the air, and no more need its defence.

THE PETALS, which are ſix, ſurround the ſame number of FILAMENTS, and in the midſt of theſe is the more drooping STYLE.

THE

THE conſtruction of the ſtalk is the ſame with that of the fibres of the root; and the ſeveral parts of the plant follow the like rule.

THE principal veſſels and fibres of the ſtalk may be traced, in a ſtrait courſe, from the extreme pars of the root, to the ſummits of the ſix filaments in the flower; which properly terminate the vegetation. This I have ſhewn by diſſection, and maceration of the parts: and I am extremely obliged to Mr. *Lee*, nurſeryman at Hammerſmith, who, for the ſpace of ſix weeks, from the middle of *February* to the end of *March*, ſupplied me almoſt daily with freſh plants in flower for the experiments.

THE fibres of the root are compoſed, as in all other vegetables, of five ſubſtances. 1. An OUTER BARK, and, 2. an INNER RIND, 3. A SINGLE COURSE OF LARGE VESSELS, 4. A FLESHY SUBSTANCE, and,

5. A

5. A CENTRAL PITH. Of theſe five parts, it will be proper to treat diſtinctly; beginning with the outermoſt: ſeparating them, and caſting them off as we proceed. This way, we ſhall learn the courſe and uſe of the veſſels and fibres of each.

THE extreme filaments are the true root of the plant: the Bulb from which they ſpring, being only, as in other kinds, a covering of the infant ſhoot; ſuch as the buds of trees, and the bulbs upon the ſtalks of SAXIFRAGE, and certain LILLIES.

CHAP. III.

THE COURSE, USE, AND TERMINATION OF THE OUTER BARK.

THE outer bark of the fibres of the root in this plant becomes the outer ſkin of the ſtalk, acquiring greenneſs when it riſes into the air.

THIS, after having covered the whole ſtalk, forms the ſcabbard of the flowers; and there terminates abſolutely: all its fibres and veſſels, contracting there, and looſing themſelves at its top and edges in cloſed ends. No part of them are ſent into any other ſubſtance of the plant.

CHAP IV.

THE COURSE, USE, AND TERMINATION OF THE INNER RIND.

THERE remain to form the flowers and their foot-ſtalks only four parts, the inner rind, the ſingle courſe of veſſels, the fleſhy ſubſtance, and the pith.

THE outer bark being ſeparated, and peel'd off, the inner rind preſents itſelf. Its veſſels and fibres proceed in a ſtrait courſe from thoſe of the root thro' the bulb, and up the whole length of the ſtalk; at whoſe ſummit they divide into two parcels, and form two cluſters; each making a knot, from which riſes the foot-ſtalk of a flower. On theſe parts this rind naturally

turally appears naked, the outer bark having terminated in the ſcabbard.

The veſſels and fibres may be traced by the help of maceration in theſe knots. They do not terminate in them, but after a few windings, paſs thro' them; and are continued forward up the rind of the foot-ſtalks.

At the Top of each Foot-ſtalk there is another knot or cluſter of them; in which, after a few windings, they form themſelves into a broader coat. The ſingle courſe of large veſſels appears alſo on the inner part of them very diſtinctly.

They form together the ſhell or ſubſtance of the ſeed-veſſel, whoſe rudiment in this plant ſtands under the flower; and is one continuous ſubſtance with it.

All this is form'd by the inner rind of the fibres of the root, continued, under cover,

through

through the ſtalk, and naked on the foot-ſtalk, and on the ſeed-veſſel.

FROM the head of the rudiment of the ſeed-veſſel, this rind is continued in a ſingle Body a little way, and then dividing into ſix parts, it ſpreads out into the ſix petals of the flower.

THESE are formed only of the rind of the foot-ſtalk; and the change of colour is worthy obſervation. In the root this ſubſtance, which is there the inner Rind, is of a reddiſh brown; in the ſtalk it is of a ſtrong green; this colour it preſerves in the foot-ſtalks of the flowers; in the rudiment of the capſule it is of a deeper green; in the baſe of the flower, which is placed immediately above this, it is paler; and thence by degrees, as it aſcends the petals, it becomes ſpotted with red, and afterwards red entirely.

THE veſſels and fibres of this part are very conſpicuous in the flower; and they terminate abſolutely at the ſides and tops of the petals: as thoſe of the outer rind did in the ſcabbard.

THUS we ſee the end of the ſecond coat of the plant; and there remain the three others entire, for the conſtruction of the ſeveral parts of fructification.

CHAP. V.

THE COURSE, TERMINATION, AND USE OF THE SINGLE SERIES OF VESSELS BETWEEN THE INNER RIND AND FLESHY SUBSTANCE.

IN the conſtruction of the outer bark and of the inner rind, there are mixed with the ſap-veſſels, fibres in which I have never been able to trace any cavity; and air-tubes in great abundance: but 'tis not ſo in regard to the veſſels next under, or within the inner rind.

THESE are large and few: they are continued in a regular chain all round the ſtalk, between the inner rind and the fleſhy ſubſtance: and there are no other veſſels or fibres mixed among them.

THESE I have traced in well macerated, and afterwards in freſh diſſected ſtalks, in an uninterrupted courſe along the main ſtem, thro'

thro' the knots at the diviſion for the origin of the foot-ſtalks of the flowers, thro' thoſe foot-ſtalks and thro' the rudiment of the ſeed veſſel, and the ſolid baſe of the flower; but they do not run up the petals, thoſe being form'd only of the inner rind.

THESE veſſels terminate within the body of the flower, juſt above its ſolid baſe: but they communicate in a wonderful manner by lateral branches with the veſſels of the filaments, which run cloſe to them.

THERE is a part in this flower which, tho' extremely ſingular and elegant, no author has hitherto obſerved. Linnæus, who has otherwiſe very correctly given the character of the Amaryllis, has not mentioned it: but 'tis eaſy to know, from his manner in other caſes, that when thus pointed out to him, he will call it the NECTARIUM, or its ſeveral diſtinct portions, the NECTARIA of the flower.

THESE parts are too conſiderable to have been made without ſome purpoſe. It is

but lately the Nectaria of flowers have been known; and those who did not take them into the account of generation, could not explain it rightly.

In this Nectarium the single course of vessels terminates: and for its use they are plainly ordained by nature.

When a flower of this plant is perfectly open, if we look steadily into it, we shall see near the base of each petal, between that and the filament, a tuft of feathery matter. See Pl. 1. fig. 1. There are six of these tufts, and they are the parts here treated of: but the filaments, in every view, hide some of them. To obtain a better sight of them, the flower should be cut off transversely at the upper part of its base, just where it begins to divide into petals: thus the petals and filaments being removed, these tufts will appear very distinctly. See Pl. 1. fig. 2.

They

THEY are colourleſs in themſelves, but they appear greeniſh from the green baſe of the flower which is ſeen thro' them: they are ſo large and obvious, that one wonders they have not before been obſerved: they are equal in number to the petals; but they do not riſe from theſe; but in the very clefts formed by their diviſions.

THE deeper the parts lie, the more care is required to trace them: but the ſingle courſe of fibres may be followed from the root up to theſe ſix bodies, in which they terminate; as the veſſels of the outer rind to the ſcabbard of the flowers. I have many times done this happily.

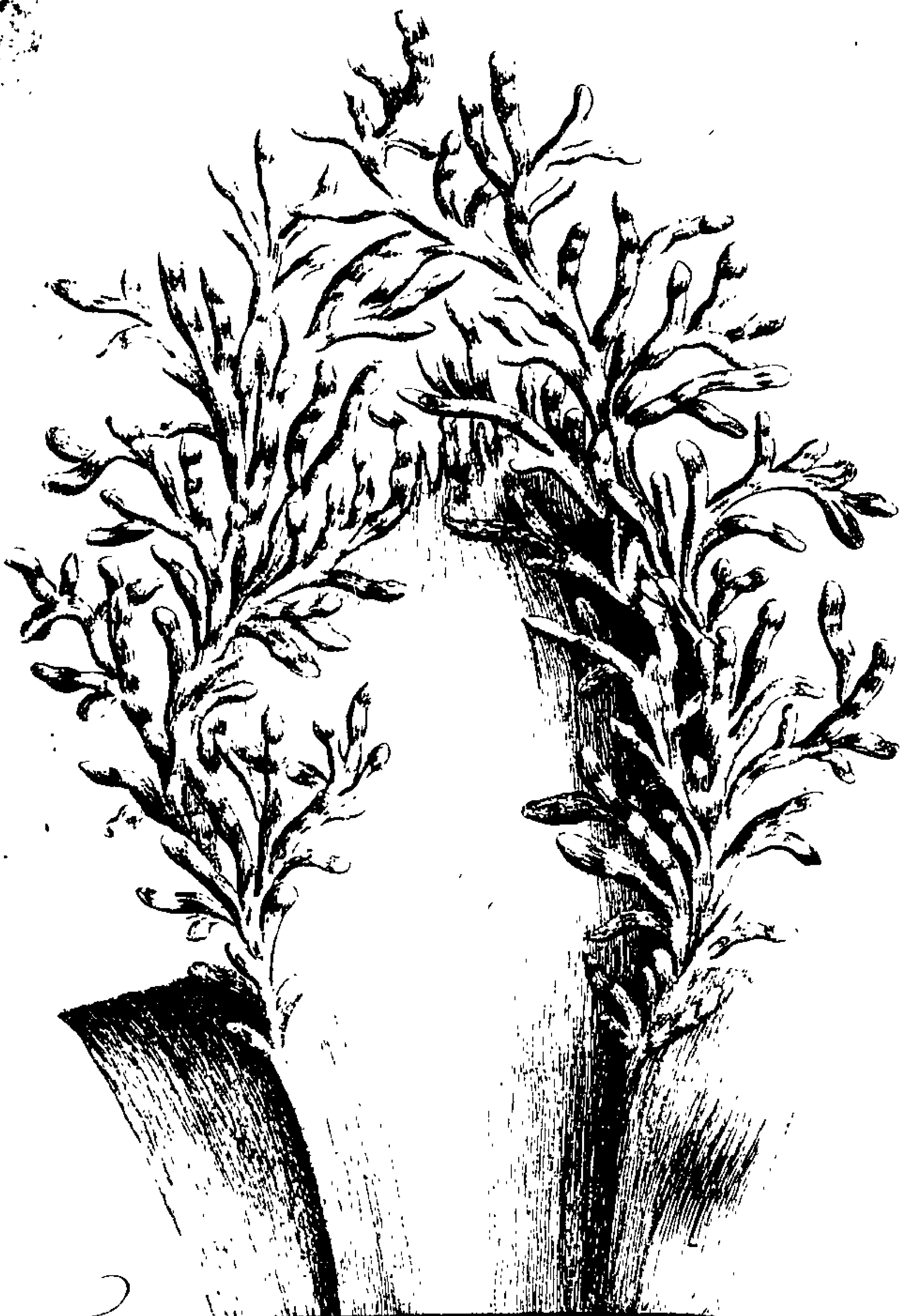
ONE of theſe parts, ſeparated from the baſe of the flower, I have repreſented in Pl. 2. as it appears before the microſcope. The body of it is hollowed, and the top and ſides are jagged. The veſſels at the baſe have formed a continuous ſubſtance; but in theſe parts they ſeparate again, and they terminate in

rounded and closed ends, without the least aperture any where.

A microscope of a single lens is best for this examination; and I scarce know a more pleasing object. The whole resembles a piece of fine white coral, but that 'tis pellucid as water. See Pl. II.

When the stalk of the plant is cut transversely, a great quantity of watery juice comes from the mouths of the other vessels: but from these, in particular, there issues a more tough and clammy fluid. This is of a peculiar nature: it is the same in the tufts themselves: It is most tenacious just as the flower is opening; and is at that time also most abundant.

Thus terminate the vessels of the third series.



The NECTARIUM of the AMARYLLIS.

J. Hill del et Sculp.

CHAP. VI.

The Course, Termination, and Use of the Fleshy Substance of the Stalk.

THE plant being thus cleared of its outer and inner rind, with which laſt this ſingle courſe of veſſels alſo uſually comes off, the inner parts of the ſtalk and foot-ſtalks appear diſtinctly. The petals and the tufts at the baſe of the flower being now alſo removed, there remain only the Filaments and Style, in which the veſſels of this inner part of the ſtalk can terminate. To trace theſe, the whole foot-ſtalk muſt be ſplit into thin pieces, and the baſe of the flower with it.

We have ſeen diſtinctly where the inner rind has run up into the petal of the flower; ſwelling in thickneſs, and becoming pale, firſt inwardly, and then entirely; and from that paleneſs red.

THE fleſhy ſubſtance, which conſtitutes the principal part of the ſtalk, is eaſily traced along the foot-ſtalk of the flower within the green rind; making alſo its principal ſubſtance. Thence it follows the rind, and the ſingle courſe of veſſels round the rudiment of the fruit: and at its top terminates moſt diſtinctly in the ſix filaments of the flower.

BETWEEN theſe and the baſe of the ſtyle, there is an abſolute ſpace: and the continuation of the fleſhy ſubſtance of the ſtalk up the filaments, is moſt diſtinctly ſeparated from that organ.

THE filaments plainly have their origin at the head of the rudiment of the fruit: they run looſe and free with their true rounded outline on the inner part: on the outer, they are flatted, and are preſſed cloſe towards the thickened portion of the outer rind, where it begins to form the petal. But they are diſtinctly

and moſt plainly ſeparated from it by the ſingle courſe of veſſels. Theſe accompanying the FILAMENTS and baſe of the PETALS ſo far, and ſerving as an union between them, terminate juſt above the part where the filaments ſeparate, in thoſe tufted bodies before named.

THE fleſhy ſubſtance of the ſtalk being at this part diveſted of its three coverings, and even of the pith within, forms itſelf into ſix aſſemblages of a rounded outline, and is continued in each nearly to the length of two inches: theſe are the FILAMENTS.

EACH filament grows ſmaller toward the top; and at its ſummit becomes indeed extremely ſlender.

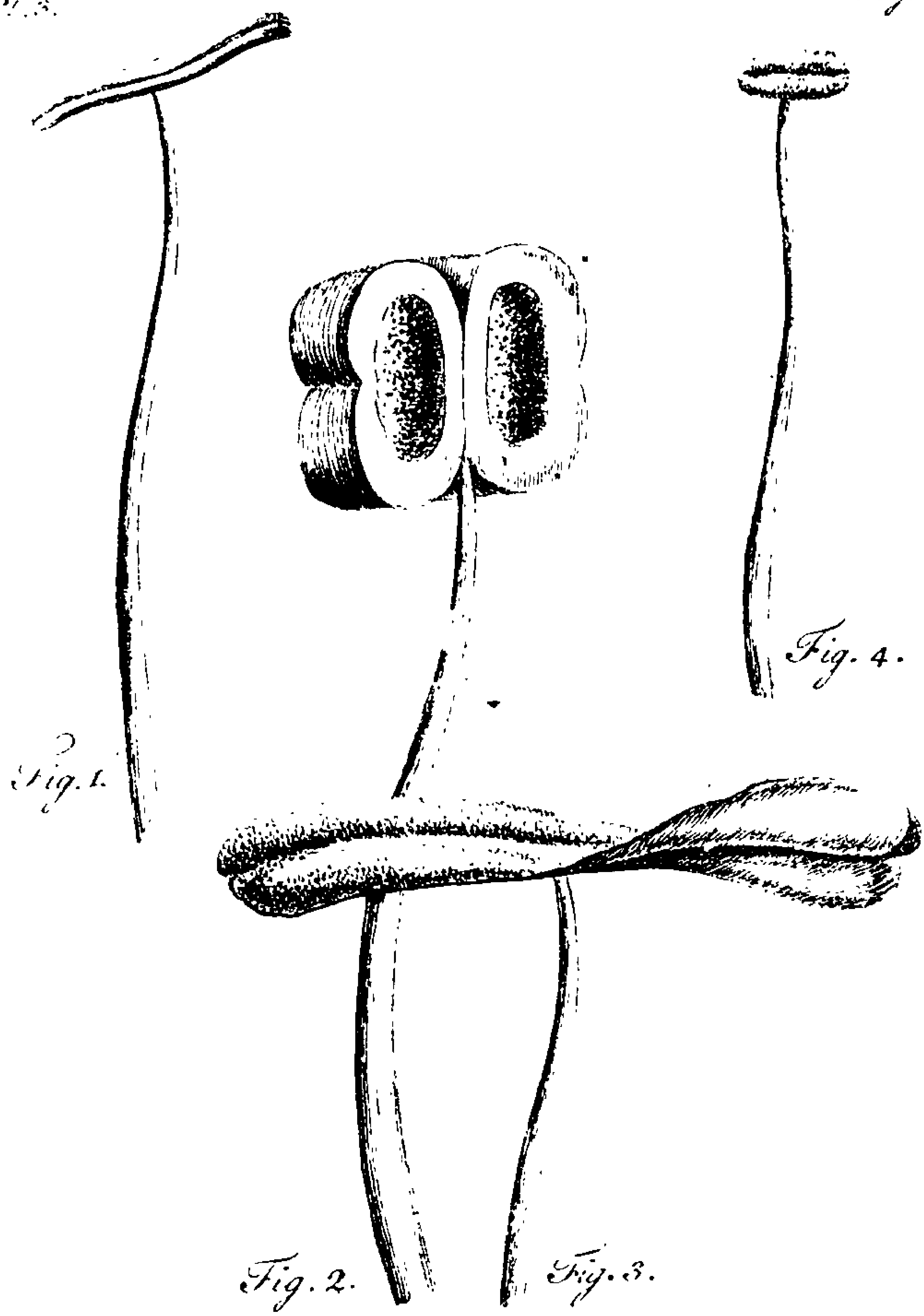
FROM this point the membrane, which had covered it throughout its courſe, dilates, and forms a regular, large and oblong ANTHERA, white at the firſt, and conſiderably long: afterwards ſhorter and yellow.

THE

THE filament has no hollow, but is compoſed ſolely and diſtinctly of the fleſhy part of the ſtalk: and the ſame veſſels are ſeen in the ſtalk and here.

THE ANTHERA, examined with a microſcope, appears of a regular and beautiful ſtructure. It is compoſed of two tubes, laid cloſe to one another, each having a groove in the middle. Its outer rind is white, thick and ſpungy; and the two cells are full of a yellow powder, which is the farina. See Pl. III. fig. 1. 2.

WHEN the anthera is ripe, each of its tubes burſts at the groove, and the two ſides ſeparate and turn back. Fig. 3. In this operation the ſpungy ſubſtance of the tubes contracts itſelf; by which they become ſhorter: fig. 4. and the yellow colour is owing to the grains of the yellow farina with which they are covered. If the flowers be carefully watched, this is eaſily ſeen; for the operation laſts in each anthera two or three hours.



FILAMENTS of the AMARYLLIS with their ANTHERÆ.

J. Hill del. et Sc.

I have obſerved, that the fleſhy ſubſtance of the ſtalk is compoſed of fibrous as well as vaſcular parts; and I have found by manifold experience, that this is the eſſential part of plants: all the buds being productions of it thro' the rind. This has been attributed to the medullary or central ſubſtance, but experiments ſhew otherwiſe.

THE tubes of the ANTHERA, which are of a looſe ſubſtance, are formed of the fibroſe portion of this fleſhy part of the ſtalk; and the farina of the vaſcular.

THE formation of this is the great object of nature in the growth of plants: and the preſent ſubject affords an opportunity of tracing it moſt plainly.

ALL the particles of the farina are of a regular figure and conſtruction. They are the extreme terminations of thoſe veſſels which form the fleſhy ſubſtance of the ſtalk: and each of theſe terminates in a minute rudiment of a fu-

tureplant, carefully and elegantly ſurrounded with membranes; which defend and preſerve it till it comes into the ſeed-veſſel.

THIS is a new doctrine: but it is founded on the plain conſtruction of the parts. That none have eſtabliſhed it before, is owing to no one's having purſued the courſe of the ſeveral veſſels in plants with attention; or obſerved this moſt eſſential ſubſtance, the FARINA, with ſufficient magnifying powers.

CHAP. VI.

OF THE FARINA OF THE PLANT.

EACH grain of the FARINA in this plant is an oval body, compoſed of three parts, a membranaceous covering, a pulpy matter, and a ſimple but continuous internal ſubſtance.

EXAMINED with a powerful microſcope, each grain is found to adhere by its larger end to the inner ſurface of the tube of the ANTHERA: there is an opening where it thus adheres; and this is continued along the body in form of a ſlight furrow, to the other end.

WHEN the farina is examined by the reflecting microſcope in water, the membranaceous covering appears tranſparent, and the contained ſubſtance is continued along its whole length: but it is not nearly equal to the breadth of the covering.

At the lower end of this is ſeen, as it were, a little bulb, where it adhered to the anthera: and from this is continued a ſingle waved leaf, graſſy and long. See Pl. IV. fig. 1.

This is the rudiment of the future plant: it is the extreme termination of the vaſcular part of the fleſhy ſubſtance of the root, and ſtalk; which never terminate any otherwiſe.

Around this minute plant there is collected a vaſt quantity of tough and ſemipellucid matter in globules; and it is generally cloſer preſſed at the top than elſewhere, becauſe the farina is there narrower; ſo that it ſometimes reſembles a ſecond bulb. Fig. 2.

This is the original appearance of the globule of farina: but when it has lain ſometime in water, it thus prepares for burſting.

The whole globule grows ſhorter, and the included plant, with its pulpy matter, is drawn into a ſmaller compaſs. Fig 3. and 4. Soon after, the globule burſts along

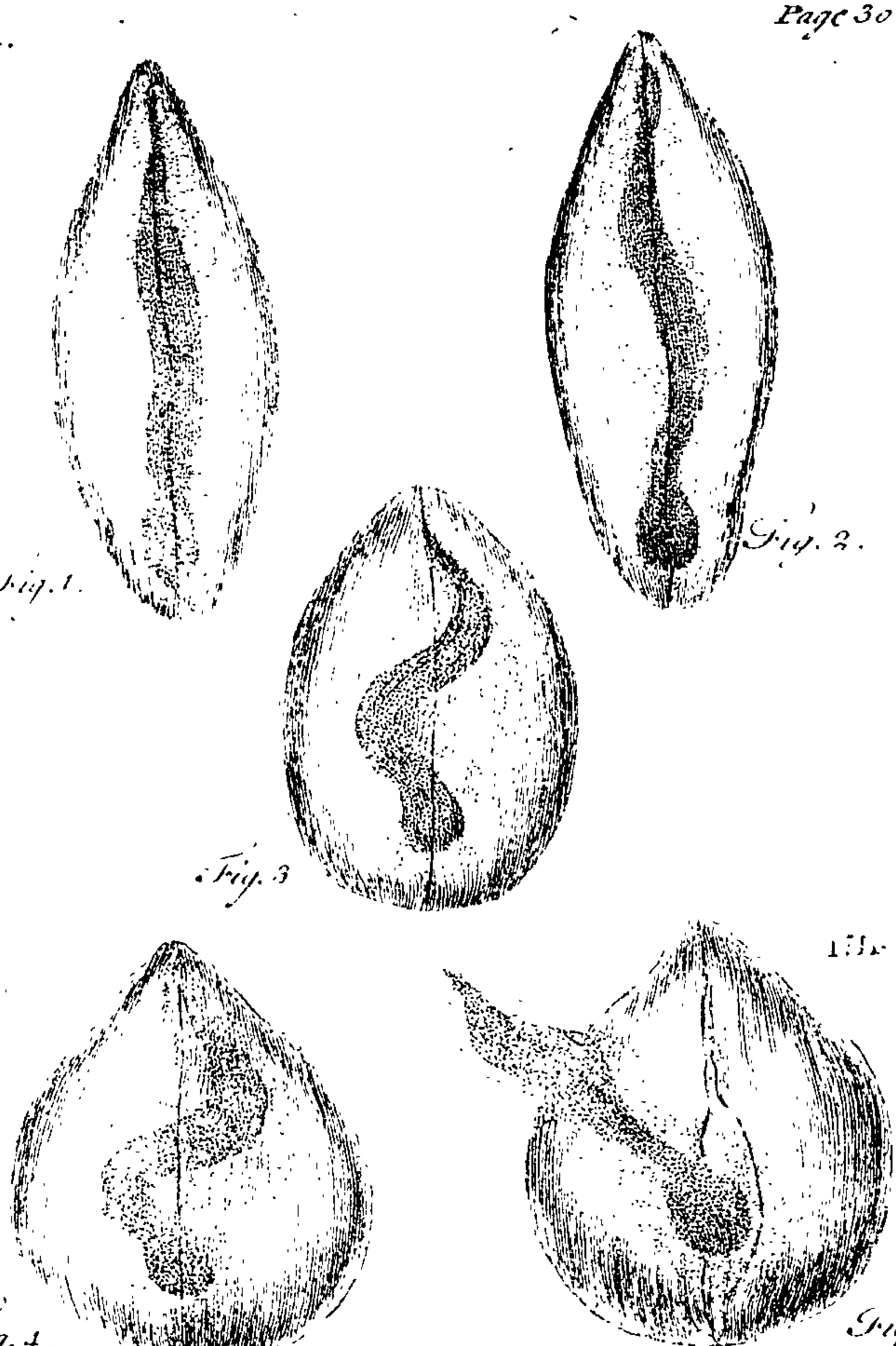


Fig. 1. Fig. 2. Fig. 3 Fig. 4. Fig 5

Farina of the Amaryllis

I Hill del et Sculp.

the furrow, and the rudiment of the future plant, together with its pulpy matter, comes out of it. Fig. 5.

THIS happens in the courfe of nature; as well as in water before the microfcope: and we fhall fee prefently what becomes of the inclofed fubftance. Firft it will be proper to underftand perfectly the thing itfelf.

THE extreme growth of a plant is thus found to be the rudiment of another plant of the fame kind: this is enclofed in a membrane, which, I think, is double; and is placed within a tube at the extreme part of the plant.

IF the rudiment were not thus defended, its tender fubftance would wither as foon as it was formed.

ALONG the ftalk, juft over the flefhy part from which this minute rudiment is produced, we fee a peculiar courfe of veffels fecreting

a tough matter, differing from the other juices of the plant.

THESE veſſels terminate in the NECTARIA at the baſe of the filaments : and thoſe NECTARIA are compoſed of veſſels cloſed at their ends ; in which this tough juice is perfected.

THESE veſſels, we have ſeen, communicate with thoſe of the FILAMENTS : therefore the tough juice they contain is delivered into the veſſels of the FILAMENTS , and is ſo carried up to the ANTHERÆ.

THE membrane or bladder, containing the rudiment of the plant, is much too large for that minute original : this is deſigned by nature to give room to a peculiar ſubſtance intended to be ſpread about it for its protection, and defence.

THIS peculiar ſubſtance is the tough juice, ſecreted in the NECTARIA or extremities of the ſingle courſe of veſſels : and this being delivered from them into the veſſels of the filament, is carried up thro' them to the ANTHERÆ and de-

delivered into the globule of farina, at that part where it adheres to the inner coat of the tube.

This tough juice is true fluid wax. It is well known that bees collect their wax from the Antheræ of flowers; and this is the original ſubſtance. They feed upon the globules of farina; the vegetable rudiment ſerves them as nouriſhment; and this tough ſubſtance is diſcharged again at their mouths, and being thus ſeparated from the minute plant and its juices, it is true wax.

No ſubſtance could be ſo proper for defence of the rudiment of the plant; for this is tough and ductile, ſo that it will paſs with it thro' the neceſſary channels; and not ſeparate from it: and it cannot be diſſolved, and waſh'd off from it; becauſe wax is indiſſoluble in water.

Thus is the new plant produced from the extreme part of the old: and thus it is encloſed and defended. But this membrane would ſoon ſhrivel; and this pulp of waxy matter decay; and the young plant

would be incapable of preſervation, till the induſtry of man, or accidents of nature, committed it to the ground. It is, therefore, lodged afterwards in the ſeed; and there defended ſufficiently.

Before we advance to this laſt conſideration, it may not be improper to obſerve, that this conſtruction of the farina, tho' different from what former authors have deſcribed, does not contradict the truth of their repreſentations.

They ſay the globule of farina burſts, and diſcharges a quantity of atoms: the waxy ſubſtance, not mixing with the juices of the plant, which are watery, always appears compoſed of minute and ſeparate particles, even in the body of the globule; and when it is diſcharged into the water, in which the farina is laid before the microſcope, it appears ſtill more diſunited. Theſe little particles were, perhaps, what they have called atoms; and they did not obſerve the rudiment within.

CHAP. VI.

Of the Course, Use, and Termination of the Pith.

THE Pith is the innermoſt ſubſtance of a plant, of whatſoever nature or conſtruction that be.

In the fibres of the root of this *Amaryllis*, it forms the central part, and it is like the other portions of the root, continued up into the ſtalk: but this ſtalk being hollow, it only forms the inner lining of it. 'Tis placed under or within the fleſhy ſubſtance which terminates in the filaments; and it forms the ſtyle and the inner coat of the ſeed-veſſel; which is, indeed, a continuation only of the ſame ſubſtance.

The four other coats of the plant being laid open, or by a careful maceration removed, this central matter appears: and we may purſue its courſe eaſily thro' the plant,

from the extreme fibres of the root, to the ſtigma or head of the ſtyle.

THE others, by degrees, leave it; terminating in the ſeveral parts we have named: and its final courſe, under covert of any them, is in the rudiment of the ſeed-veſſel.

HAVING made the inner coat of this, it contracts itſelf into a kind of neck in the top of that rudiment: and this being continued in length, forms the ſtyle; which accompanies the filaments a little way, but then droops under them, and exceeding them in length, terminates in a ſtigma or head, divided into three rounded parts.

CHAP.

CHAP. VII.

THE CONSTUCTION OF THE STYLE OF THIS AMARYLLIS.

THE central ſubſtance in this plant is every where looſe and ſpungy; compoſed of large veſſels, and abounding with a watery juice.

THE ſtructure is the ſame in the ſtyle: this is looſe, ſpungy, tender, and watery; and is only covered with a thin membrane.

IT has been thought eſſential to the fœcundation of the ſeeds in plants, that the ſtyle ſhould be hollow: many have been perplexed at not finding it ſo; and ſome, to the ſcandal of philoſophy, have figured hollow ſtyles, where they did not find them, to favour their ſyſtems.

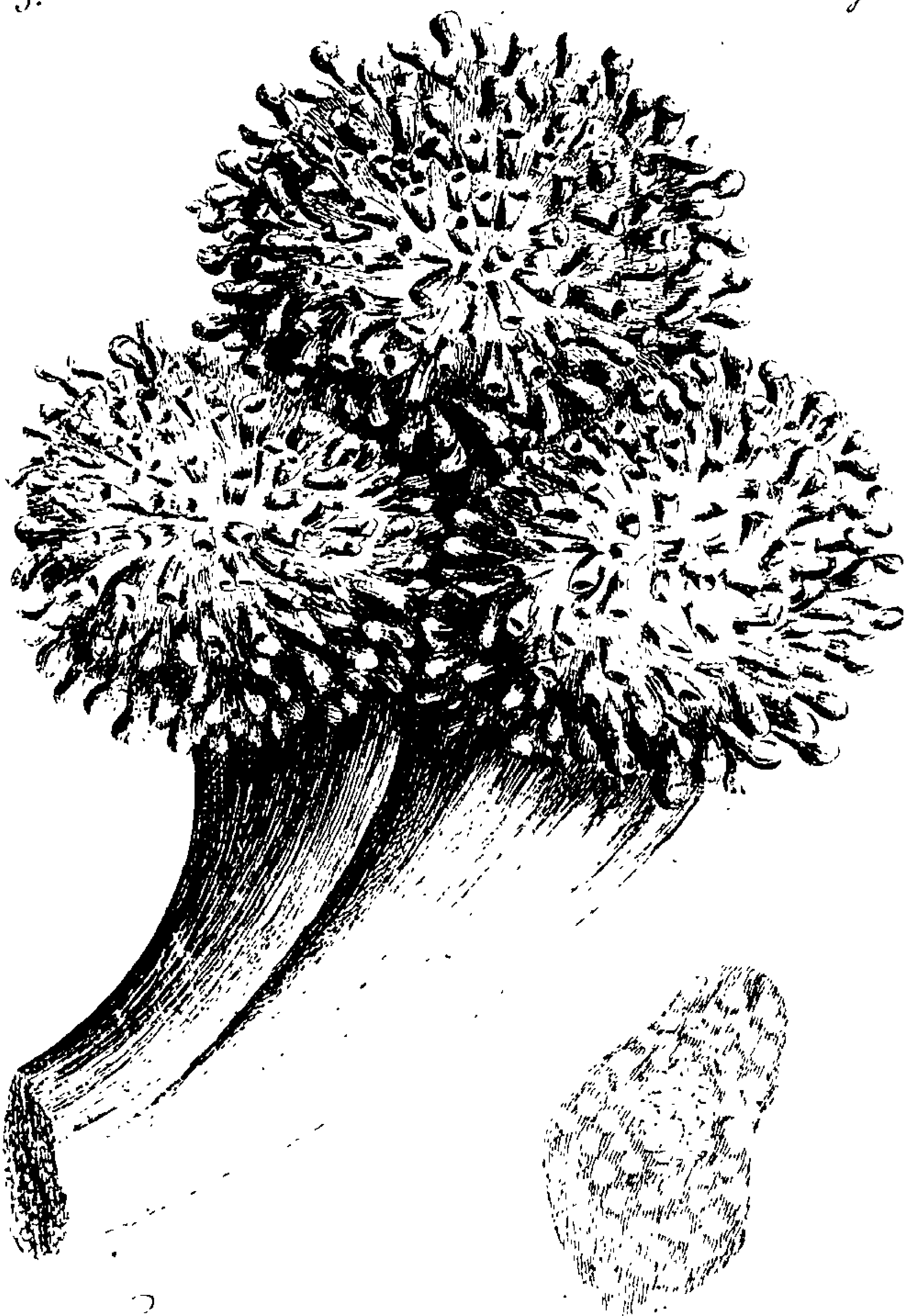
In this plant the ſtructure is eaſily traced, and it is highly elegant. The ſtyle has not an abſolute cavity, but the purpoſe of ſuch a one is plainly anſwered ; and we ſee how.

The ſtigma or head of the ſtyle, which is the extreme part or termination of the pith of the plant, viewed with a microſcope, appears compoſed of three rounded parts, reſembling irregular ſegments of ſpheres : and the whole ſurface of theſe is covered with prominent tubercles white as ſnow. See Pl. V. fig. 1.

The general colour of the ſtyle is crimſon ; and ſuch is the outer part of each of theſe diviſions of the head ; but in the midſt of each is a white ſpungy ſubſtance.

The prominent particles on the verge of each diviſion of the ſtigma are cloſed at their ends, and even thickened in a clavated manner : but thoſe which riſe from the white central part of each diviſion are open : they

are



The Stigma of the Amaryllis.

[illegible] del. et Sculp.

are the mouths of ſo many tubes, and they are larger than the others.

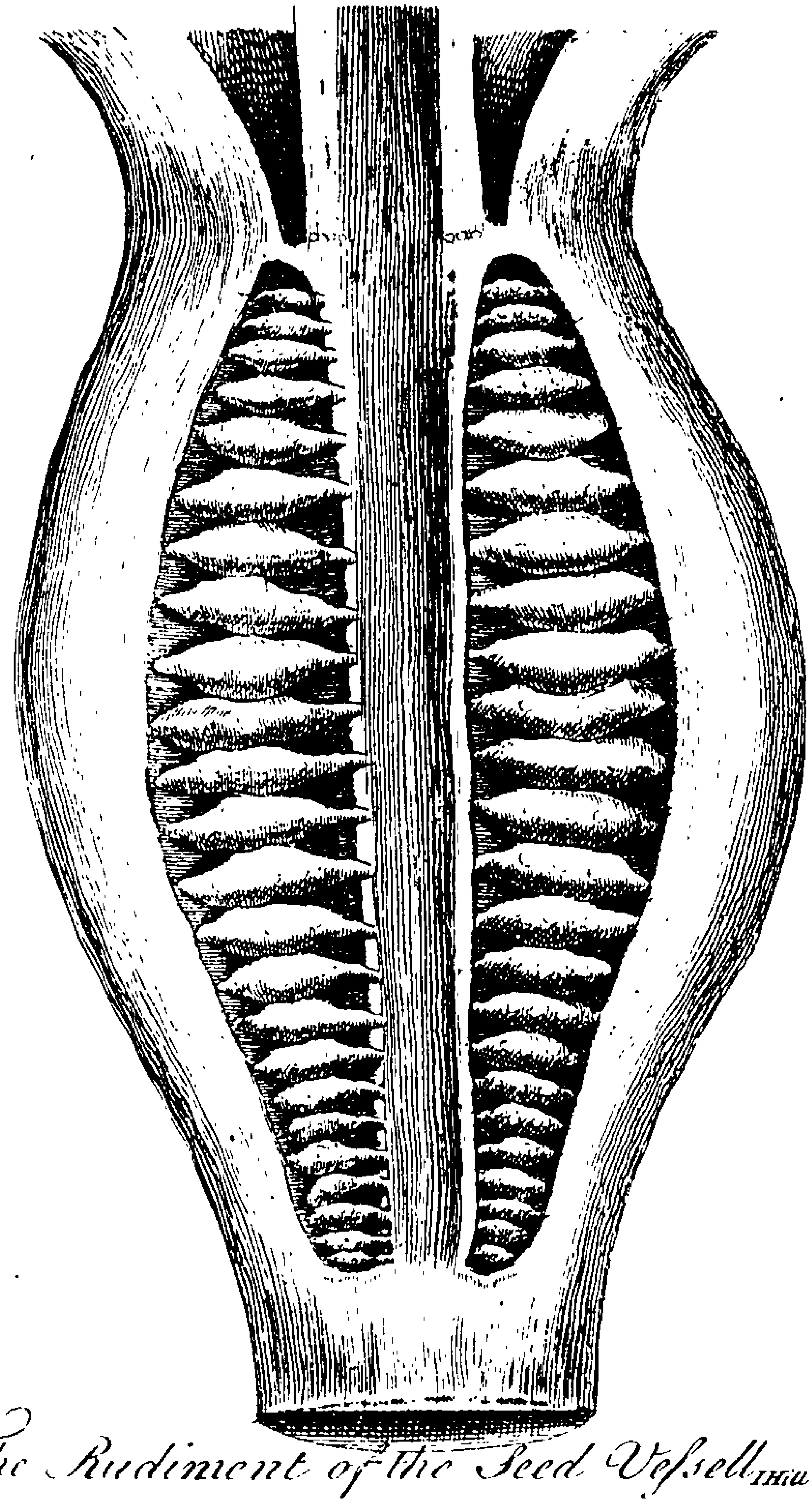
THE open mouths of theſe are wide enough to admit, with eaſe, one of the minute rudiments lodged in each grain of the farina; with its pulp of waxy matter about it.

THE three general paſſages from the ſeparate portions of the ſtigma, unite at a ſmall diſtance below that part, and from one common paſſage of the ſame kind; which may be diſtinguiſhed in a tranſverſe ſection of any part of the ſtyle. See Pl.V. fig. 2. And when that organ is opened longitudinally, with due care, this paſſage ſhews itſelf in its ſingle ſtate along the ſtyle, with its diviſion into three branches for the three parts of the ſtigma. In the lower part, it does not terminate with the reſt of the ſtyle, but is continued in form of a column, thro' the centre of the ſeed-veſſel, every where united to the rudiments of the ſeeds.

THIS central part of the ſtyle is form'd of the largeſt veſſels of the pith of the plant, with ſome few air tubes intermixed, and a very ſmall number of hard fibres.

As the vaſcular part of the fleſhy ſubſtance of the plant ſwelled out into veſſels or membranaceous bladders in the antheræ; in the ſame manner the vaſcular part of this pith, where it runs like a column down the centre of the ſeed-veſſel, ſwells out on every ſide into the ſame kind of bladders: and theſe are the ſhells of ſeeds. Pl. VI.

ALL this may be diſtinctly ſeen in the new form'd rudiment; and the only difference between theſe ſhells of the ſeeds and the membranes of the farina is, that they are more firm, and have about them ſomewhat of a ſpungy ſubſtance.



The Rudiment of the Seed Vessell J Hill del et Sculp

CHAP VIII.

The Manner of Impregnation.

THIS is the ſtructure and conformation of the AMARYLLIS here deſcribed: and thus the method of impregnation is eaſily ſeen. Like all the other operations of nature, being truly underſtood, it is found much more plain and ſimple than men of contemplation had imagined.

THE fleſhy ſubſtance of the root and ſtalk is the eſſential part of the plant: its growth is the growth of the plant; and nature has for this reaſon lodged it under three coverings from the outer air, and under the defence of a fourth within the hollow ſtalk.

THIS part, in the common growth and encreaſe of plants, continues, and protrudes itſelf downwards in the fibres of roots, and upwards in ſtalks and branches: this puſhes

out

out ſmall rudiments of the entire plant in form of buds along the branches; and this terminates in the ſame kind of rudiments, tho' extremely minute, in the ANTHERÆ on the heads of the FILAMENTS: theſe parts being the final terminations of its growth.

THE rudiments, which this fleſhy ſubſtance ſends out in form of buds on the branches, are defended by many films; and theſe, which terminate its growth in the Antheræ, have their membranaceous covering alſo; and within it a pulpy matter, indoſſoluble, as we have ſhewn, in water, yet eaſily ductile.

THESE are too tender to be truſted to the air; and the courſe of nature being irregular in their falling to the ground, as winds and ſeaſons vary; this is the method of their preſervation.

WHEN the flower is newly opened, the Antheræ are long and white, therefore they are entire; and the ſtigma is ſmall, flattiſh, and dry.

WHEN

WHEN the Antheræ burſt, the ſtigma ſwells; its three diviſions become more prominent; and the white particles riſe higher above their ſurface.

THE Antheræ contract and harden ſoon after they are opened; and by this means the grains of farina are rendered looſe upon them; and the leaſt motion of the air ſhakes them off. Multitudes are ſcatter'd and loſt; but a great many fall upon the ſtigma: and whatever falls there, is detained by its rough and froſted ſurface.

THE top of the ſtigma is always moiſt; and we ſee under the microſcope the effect of water on the grains of farina: they burſt in it; and diſcharge their contents.

IT is the ſame when they fall upon the ſtigma, loaded as it conſtantly is at that time, with moiſture. They burſt; and there thus iſſues out of each grain of farina a minute plant,

ſur-

ſurrounded every way with a tough, ductile, and indiſſoluble ſubſtance.

The mouth of a tube is open to receive this; and the courſe of the tube is with an equal diameter through a ſpungy part in the centre of the ſtyle.

The inſide of the tube is moiſt; and the minute rudiment thus received into it is forced along by the ſame power by which leaves and all other parts of plants imbibe dews, and tranſmit the moiſture inwards.

The minute plant thus carried thro' the length of the ſtyle, and into that part of it which runs like a column down the centre of the ſeed-veſſel, can be forced no farther, for there is no more paſſage: this ſpungy column has no communication but with the ſtyle itſelf. We have ſeen that on each ſide its vaſcular part has formed a kind of ſhells or bladders: the paſſages into theſe are open; and

and the minute rudiment is naturally forced into one or other of them.

In this manner, the firſt grains of farina, which fall on the ſtyle, deliver their rudiments of plants to the tubes; and all the ſhells of the ſeeds are, in ſucceſſion, occupied.

As ſoon as this is done, the ſtyle having performed its office, fades: and all that appears to receive any nouriſhment from the root, is the ſeed-veſſel. The ſhells of the ſeeds become thickened; and a farinaceous ſubſtance, formed of the drying juices of the vaſcular part of the pith, ſurrounds the minute plant in that covering: thus is the ſeed compleated, and vegetation in the plant then ſtops entirely.

Each thus ſeed contains a minute plant, ſo well defended, that it can bear, like that in a bulbous root taken out of the earth, the common injuries of the ſeaſons: and when committed to ground at a time when there is

is due heat and moiſture, it grows as the rudiment in the root; and in the ſame courſe forms its own ſeeds again.

This, by the preſent example, appears to be the courſe of nature in the production of plants: and if it ſhall be confirmed in others, we ſhall have no need any more to have recourſe to elaſtick atoms, or impregnating air: what is called the production of new plants will be found nothing more than the continued growth of the old: the rudiment in the ſeed being only a piece of the fleſhy ſubſtance of the ſtalk delivered into that part from the globule of farina; and with the requiſite heat and moiſture continuing to grow.

F I N I S.

A

METHOD

OF PRODUCING

DOUBLE FLOWERS

FROM

SINGLE,

BY A

Regular Courſe of CULTURE.

Illuſtrated with FIGURES.

The SECOND EDITION.

LONDON:

Printed for R. BALDWIN in Paternoſter-row.
MDCCLIX.

DEDICATION.

To the Celebrated

Dr. HALLER.

SIR,

IT is not that I ſuppoſe my weak voice can return the honour you have been pleaſed to do me, by the mention you have made, in your immortal works, of ſome of my attempts towards the advancement of botanical knowledge: that were a thought as vain, as it were idle: but where returns are impoſſible, there may yet be gratitude. I addreſs my acknowledgements to you in this ſlight Treatiſe:

 wherein,

wherein, whatever may be wanting, there yet is TRUTH: and ſome of it has not been known before.

THE World will pay a due regard to theſe doctrines, when they ſee I dare addreſs them to your experienced and diſcerning eye: and I have ſome pride in dedicating the reſearch to the eternal memory of thoſe new lights which your genius and indefatigable labours have thrown, not on this ſcience only, but on all philoſophy.

I am,

With the moſt perfect Reſpect,

SIR,

Your obedient

and humble Servant.

London,
Jan. 4, 1759.

J. HILL.

THE PRODUCTION OF DOUBLE FLOWERS.

THE raiſing double flowers is one of the great articles in the gardener's and floriſt's profeſſions. 'Tis often done: but none knows how. The practice by which theſe elegant plants are obtained from the ſingle, is little different from that by which, in other kinds, ſingle riſe from ſingle in ſucceſſion; and the procedure is merely mechanical: the gardener practiſes in his age, what he ſaw done in his youth; and he expects the ſame ſucceſs, without farther thought.

IT

It would be happy if the change thus produced in a few plants could be extended to many: and perhaps this is not beyond the human reach. To attain the end, it muſt be attempted regularly; and in order to that, the ſubject muſt be firſt underſtood.

We muſt know by what means and in what manner nature gives this doubleneſs to flowers, in the inſtances already ſeen, before we can attempt rationally to aſſiſt in her operations upon others: but when that is diſcovered, the juſt grounds of ſuch an undertaking will be known.

The ſtalk of every plant is compoſed (as has been clearly ſhewn) of ſix diſtinct ſubſtances; ſurrounding one another in a regular manner: theſe are the outer bark, the inner rind, the blea, a vaſcular ſeries, the fleſhy ſubſtance, and the pith. The roots are compoſed of theſe; they are continued thence up the ſtalk; and from one or other of them are formed the ſeveral parts of flowers.

THERE is no way to underſtand what the doubleneſs of a flower is, or of what it conſiſts, until this ſtructure of the whole plant be underſtood.

As all the parts of a flower are continuations of one or other of theſe ſubſtances, all doubleneſs in flowers muſt be owing to the luxuriance of ſome of them: nothing new is produced, nor can be; only ſome original part is extended.

THE firſt ſtep towards underſtanding the proceſs of nature, is to examine which of the proper parts of a flower has afforded the luxuriant growth: We are then to ſee to what original portion of the plant, that is to which of the ſix ſubſtances whereof the whole conſiſts, that part belongs: when we know this, we are to enquire by experiments, what nouriſhment, and what method of culture moſt favour the growth of that part: and, if we find this, we ſhall diſcover the great ſecret.

WE ſhall thus know how at our pleaſure to double the flowers of many plants;

and to produce that luxuriance in degree as well as kind.

In this courſe it is propoſed to purſue the ſubject in the preſent enquiry: determining the firſt attempt to a ſingle plant. There is no other way to avoid perplexity; and if we ſuccede in this, it will be eaſy to continue the ſame reaſoning, and the ſame practice to others.

It will be moſt uſeful to ſelect a plant, in which the parts are large and plain; and one, of which we can be ſure, during the ſucceſſive years of trial. I ſhall for theſe reaſons chuſe a Tulip. The organs in this flower are all large, the doubleneſs is not too complex, and the root being yearly taken up, we can always be ſure of having the ſame plant.

The Tulip is not ſelected as an inſtance for its beauty; for it is leſs improved by doubleneſs than many other flowers: but becauſe the parts being few, large and diſtinct, the courſe of nature may be traced in it eaſily.

Pl. 0.

THE IRREGULAR FULL TULIP.

J. Hill delin. et

GARDENERS despise double Tulips; and if no better could be produced by art than such as offer themselves to them by accident, they wou'd have reason. They see the CLERIMONT with a ragged multiplicity of ill shaped petals; or the common breeder reduced to a dwarf and edg'd with white, with a wild cluster of like petals, and the filaments irregularly dispos'd among them; or with half formed petals growing from the edge of some of the filaments, and buttons upon the irregular extremities of others. This is all they see of doubleness in Tulips; and this rises wildly. *See* PLATE (o)

BUT if doubleness in a Tulip can be produced in a regular manner, the new leaves rendered as well shap'd as the old, and the same excellence of colour preserved in these, as in the single, doubtless the florist will receive it into his list of beauties. That this may be done appears very probable; and the instances here produced shew there will be great beauty in the flowers: not only in their perfect state of doubleness, but in the several advances towards it. The attempting this regularly, is a work of time, because the

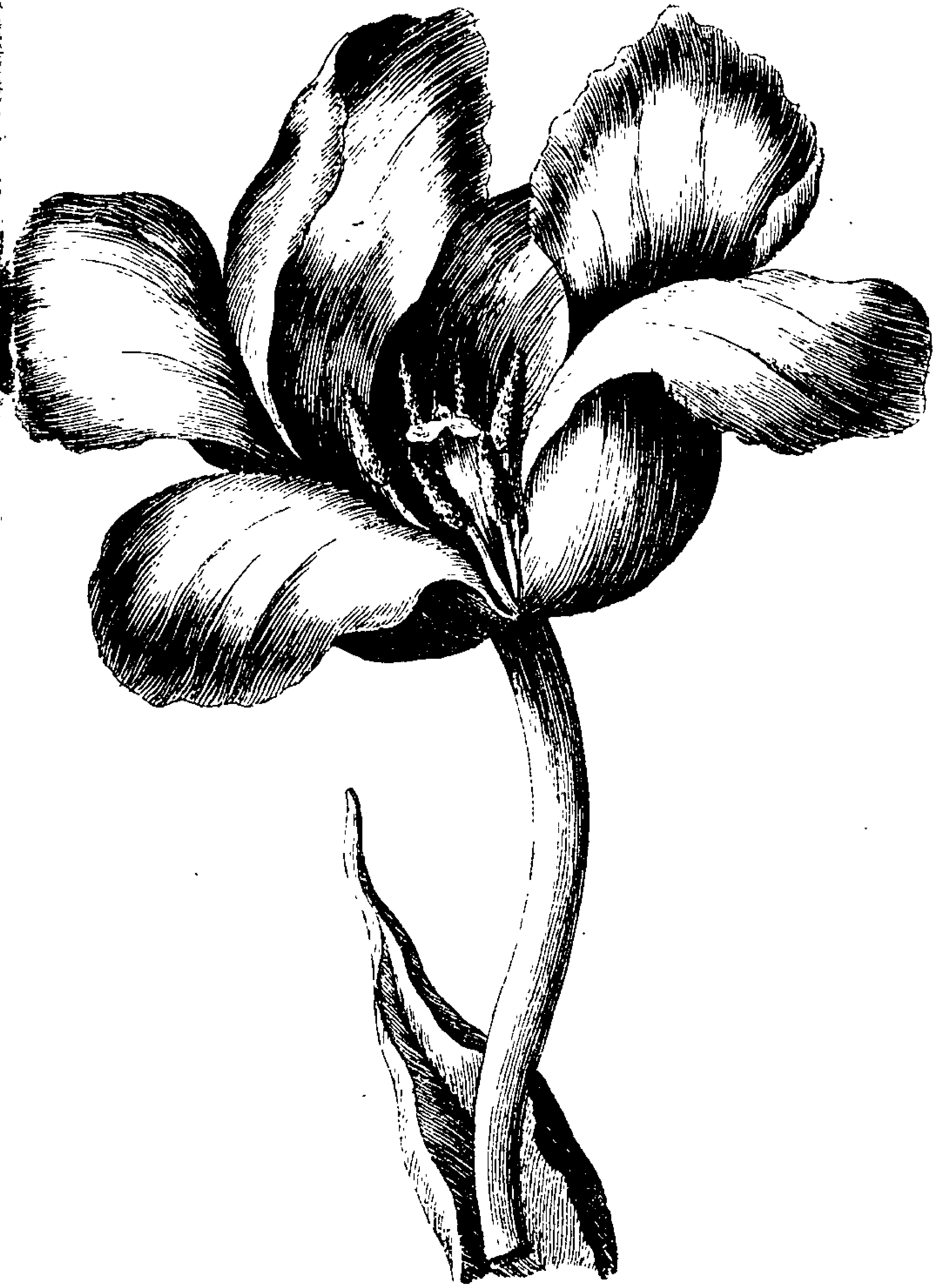
Tulip is a ſlow grower from ſeed; but by the flowers here produced there is reaſon to believe it will ſucceed: and the benefit will not end there. Nature proceeds nearly alike in her ſeveral operations, and what proſpers in one plant probably will not fail in another.

THE origin of the Tulip flower is this. The fleſhy ſubſtance of the ſtalk terminating in the antheræ, there forms a minute plant, or rudiment of a plant in each grain of the farina: this is received into the ſtigma; and thence conveyed by a ſhort courſe to the ſeed veſſel; where it is lodg'd in the yet empty hull of a ſeed *: it is there cloathed with a farinaceous ſubſtance, ſecreted for that uſe in thoſe veſſels; and, the ſeed hardening, it is perfect.

THIS ſeed being ſown, the rudiment of the plant expands by means of the heat and moiſture; and its ſeveral parts growing, downwards into fibres, and upwards into a ſtalk and leaves, the Tulip is produced, which in its perfect ſtate we are now to examine. See plate 1.

As

* This is explained at large in *Outlines of vegetable generation.*



COMMON TULIP.

I. Hill delin et sculp.

As the rudiment in the farina is very tender, it takes a long time in expanding all its minute parts, and growing to perfection: and to defend the more delicate organs of the flower the bulb is formed. This is not the root, tho' it be vulgarly ſo called, but is a germ or bud, ſurrounded by a number of coats, and films like thoſe which cover the young leaves in buds of trees.

THESE films are produced or thrown off from the outer bark of the fibres; which are the real proper and only roots: and from the innermoſt of theſe films proceed the leaves.

THE regular continuation of the four other ſubſtances is in the ſtalk and flowers: and it is performed by nature in this manner.

THE outer bark which is thin and delicate, is defended and kept moiſt towards the baſe of the plant by the lower ends of the leaves, which ſurround the ſtalk: but higher up, where it is naked, it becomes harder and ſomewhat thicker.

It runs up to the ſummit of the ſtalk, and there forming three thick knots or cluſters, is continued through them into the three outer petals of the flower. Theſe are formed entirely of it, and in theſe its whole ſubſtance terminates.

In plants which have a cup under the flower, the outer bark of the ſtalk forms that cup, and terminates in it: the ſecond, or inner rind forming the petals, by a continuation into the flower.

It has not been enough regarded; but nature where ſhe gives no cup to the flower, always allows ſomething analogous. The Tulip conſiſts of ſix petals: of theſe the three outer are harder than the three inner, and ſerve as a defence to them. They are a kind of cup to the three delicate ones within.

The outer bark of the ſtalk conſtitutes theſe three petals entirely; and it is there loſt. When the flower is newly opened, it has the property of the leaves of ſleeping plants; ſhutting itſelf together in the

dark,

dark, whether it be night or an artificial gloom; and opening again in the light.

THE cluſter of fibres at the baſe of each outer petal perform this: They are the hinges on which the motion is made; and the delicate inner petals are forced together by them. The fibres which form theſe cluſters are white; and are as ſtrong as raw ſilk.

VARIOUS accidents influence the increaſe or diminution of particular parts in the compoſition of plants, but with this outer bark we have nothing to do in the preſent reſearch: The doubleneſs of the Tulip is what we enquire into, and that ariſes only from the fleſhy ſubſtance of the ſtalk. The outer bark terminating in the three exterior petals, we are now clear of it.

IN diſſecting the Tulip ſtalk tranſverſely and along, the next ſubſtance ſeen under this is the *inner rind*. This is greeniſh, but tending to white in the inner ſurface: It continues its uninterrupted courſe to the flower, and there forms the three inner petals.

petals. These have their origin plainly from this interior rind; and the fibres may be traced down from their bases to the stalk, with great ease.

THIS coat of the plant terminates plainly and solely in these; and consisting of simple and not numerous parts, it is incapable of any increase, or division, in the flower.

THE course of examination should be to remove the several parts thus separated, as soon as we have thoroughly examined them: therefore the two rinds of the plant and the two series of petals being now cleared away, there appears as the outer substance the *vascular course*, or third portion of the substance of the plant. This is extremely delicate and small in the Tulip. In a transverse section of the stalk it appears only as a line separating the greenish inner rind from the white fleshy substance of the stem; and in a longitudinal section it resembles a mere membrane.

THE microscope shews that it consists only of a single row of vessels: it terminates

minates juſt within the baſes of the inner petals; and there forms an irregular line nearly hexagonal, with ſmall riſings between the baſes of the petals.

In many plants this part riſes up conſpicuouſly in the flower; forming what is called a nectarium. The large nectaria in the Hellebore are formed of it; and that tufted ſubſtance in the Amaryllis, examined in a preceding work *. Whether the termination of this part riſes above the ſurface of the flower, or lies within its compaſs, and hid under the ſkin of the baſes of the petals, its ſtructure at the termination is the ſame. The veſſels ſwell and are clos'd at their extremities; and they communicate with no part but the baſes of the filaments. This is plainly and evidently the caſe in the preſent inſtance; and therefore probably in all plants this vaſcular courſe ſerves the ſame purpoſe; ſecreting a waxey humour, and giving it to the veſſels of the filaments, for defending the embryo plants in the farina.

All theſe parts being cleared away we come to the fourth in order, which is the

fleſhy

* Outlines of vegetable generation.

fleſhy Subſtance of the ſtalk. This we may trace with eaſe up to the filaments themſelves, which are formed abſolutely and ſolely of it: and from obſerving its ſtructure we ſhall find the reaſon why Tulips are doubled, in the manner to be repreſented in the ſucceeding plates, more eaſily than many other flowers.

DOUBLENESS in various flowers riſes from a luxuriance of different parts: In Columbines from what are called the nectaria; which are either ſimply increaſed in number, or converted as it were into petals; and in the Narciſſus kind, ſometimes by an increaſe and diviſion of the nectarium, the petals remaining as they are naturally, ſix in number; and ſometimes by an abſolute increaſe in the number of the petals: But in the Tulip it is altogether otherwiſe; the doubleneſs of this flower ariſes from the filaments and no other part; and is accompliſhed in the ſucceeding gradations.

WE ſee by the diſſection of the plant, that the filaments are formed of the fleſhy ſubſtance of the ſtalk, or more pro-

perly ſpeaking, they are the termination of that part. During its courſe up the ſtalk it has been defended by the ſurrounding ſubſtances; but in the filaments which are expoſed to the air the membranes inveſting it become more firm, and its ſubſtance more compact: that is all the difference.

THIS fleſhy ſubſtance is remarkably thick in the ſtalk of the Tulip. Its quantity is greater than in any other plant I have examined: and hence ariſes the natural tendency of the Tulip to doubleneſs; from a luxuriance of the filaments.

THESE are in the ſtate of nature very thick in this flower, and of a peculiar ſhape and conſtitution: they are flatted, tho' irregularly, and are edged and triangulated; and they are uſually coloured. In all this they reſemble petals more than the filaments of the generality of flowers; which are uſually rounded and ſolid.

THESE in the Tulip ſhew a very peculiar conſtruction when cut open, and

examined by the microſcope. They are found to conſiſt of two parts, a ſolid central yellowiſh matter, and a coat or ſhell of a filmy ſubſtance ſurrounding it. This is looſely and eaſily ſeparated from it.

The thickneſs of the filaments ariſes from that of the fleſhy ſubſtance of the ſtalk, whereof they are ſo many continuations: and it renders them liable to alter their form by farther ſwelling, if an increaſe of that part favours ſuch change: their peculiar ſtructure alſo makes it eaſy for them to ſpread into a reſemblance of petals, the membranes covering them being much of that nature.

Thus the doubleneſs of the Tulip is produced only by a luxuriant growth of its filaments; which in that ſtate loſe their proper nature, and become a kind of petals. This flower is moſt liable to ſuch doubleneſs, becauſe the fleſhy part of the ſtalk is thick; and plainly the doubleneſs is owing to an increaſe in the quantity of that part. The practical leſſon follows hence plainly. Certain circumſtances in the culture and management of plants

favour the increafe of particular parts in their conftruction: the way therefore to produce double Tulips, and to increafe the degree of their doublenefs, is to difcover what circumftance, what foil, manner or management it is that thickens this flefhy part in fome degree: and to apply it early, and purfue it thoroughly. What may be done in this cafe we fhall fhew by declaring what has been.

As we have on this occafion named the four exterior coats of the Tulip-ftalk, it may be proper to fay what becomes of the pith, or innermoft fubftance. This is continued to the rudiment of the feed-veffel, and terminates in it. That rudiment with its ftigma, for there is no ftyle, are formed of it entirely.

CHAP. II.

Of the Progrefs of the Doublenefs in the TULIP.

THE TULIP in its natural ftate, confifts of fix petals, fix filaments, and a rudiment of a feed veffel, crowned with a ftigma, divided into three parts. See *fig.* 1.

The three principal organs of flowers are ſeen in it very diſtinct and plain, with no additional part, (as in the caſe of thoſe that have conſpicuous nectaria) nor any interruption, as in double flowers.

When the Tulip alters from this plain and natural ſtate, becoming double, the courſe and progreſs of nature may be trac'd in it, in five ſtages; and theſe naturally ariſe in ſucceſſion one after another; the doubleneſs increaſing each year from the firſt.

But this, though natural, and uſual, is not an invariable courſe: ſometimes a Tulip from being ſingle, burſts at once into full doubleneſs; ſometimes on the contrary when the change has been regularly begun, it comes to a ſtand in the ſucceeding year: and any double Tulip being left neglected in the ground, will again become ſingle.

When a large quantity of the ſeeds of well choſen ſingle Tulips are ſown, and the plants are raiſed by proper care to flowering, there will ſometimes appear among the

the number a few double ones the firſt year of bloom : but this is rare ; and they are never perfect.

The full change is too great to be expected at once ; for it is an old and true maxim, that nature does nothing by leaps, but all in a regular gradation.

Among the number of Tulips thus raiſed, the greater part will be plain and natural ; but a nice and well inſtructed eye will ſee in ſome few, the firſt approach to doubleneſs. Theſe are to be ſelected ; and they are thus known.

In the natural ſtate, the filaments are raiſed in three blunt ridges, and are thick in proportion to their breadth. In ſome, theſe filaments will have loſt the outer ridge, or that at the back ; and the whole filament will be broader, thinner, and flatter than uſual ; and will begin to ſhew a different colour, tending to that of the petals. The antheræ alſo are in this caſe ſhorter.

This is the firſt approach which nature makes to doubleneſs. This the floriſt is

to mark; and the plants in which it appears are to have peculiar care in the following years.

The ſeveral gradations from this to perfect doubleneſs, are to be expected in the five ſucceeding ſeaſons.

Though the firſt approach towards this ſtate in the Tulip be ſlight, and not diſtinguiſhed, except by the inquiſitive eye; the ſecond is conſiderable, and ſufficiently plain. In this the filaments are ſo altered, that if they did not ſtill ſupport their antheræ, they would not by the common eye be known for ſuch, or called by that name: they are indeed converted into a kind of petals. They are thin like the natural petals; and a quarter of an inch in breadth: their colour alſo as well as ſubſtance is that of the petals. They riſe with a ſingle body, but at half their length they ſplit. In the cleft of this diviſion is ſeated the anthera: and the two parts of the divided filament are continued upwards in a moderate breadth, and in a waved form. *See Pl.* 2.

THE anthera in this ſtate of the flower is ſhorter, and leſs than naturally: but it ſtill ripens a perfect farina. The ſeeds of ſuch a Tulip ſeparate from all others will be perfect; and being ſown, will ſucceed very well. I name this particularly, becauſe they are the fitteſt of all Tulips from which to ſave ſeed for double flowers.

THOUGH the filaments in this ſtate of doubleneſs have changed their form and colour, their conſtruction remains the ſame as at firſt: each is compoſed of two membranes and a pulpy central ſubſtance; but this laſt part is ſmaller in proportion than in the natural Tulip. This ſeems to be the matter which immediately feeds the anthera; and therefore the farina, though leſs in quantity, yet is in this ſtate perfect.

THE third degree of doubleneſs in the Tulip extends the filament in breadth yet farther, and ſtarves the anthera entirely: therefore the flower is in this ſtate incapable of ripening ſeeds.

THE Tulip now conſiſts of twelve real petals: he who has trac'd the origin and obſerved

ſerved the courſe of the production, knows that the ſix inner ones are formed from filaments; but to another they would appear almoſt perfect as the reſt; only ſhorter and nip'd at the top. Though they have been form'd from filaments, they are now truly petals. We learn by this that nature tho' ſhe regularly forms each part of the flower from a peculiar coat of the plant, in her uſual courſe; yet can make the expanſion of another portion anſwer the ſame purpoſe.

In this ſtate of doubleneſs the original petals of the Tulip ſtand in two ſeries, in their natural order, three external and three interior; the ſix additional petals form one ſeries riſing within both: one in the center of each perfect petal, as the filaments roſe in their natural ſtate. *See Pl.* 3.

Each of theſe additional petals, for in this condition of the flower they are abſolutely ſuch, is nearly of the breadth of the original ones, but not exactly of the ſame form. There is now no deep ſplitting or diviſion into two parts at the top, as in the former condition of doubleneſs, where the anthera held its place in the center of the cleft; but the ſummit of the petals is

THE FORKED TULIP.

J. Hill delin et Sculp.

Pl. 5.

THE DOUBLE TULIP.

J Hill delin: et Sculp

is variouſly wav'd, and all that remains of the appearance of an anthera, is a point of a purple colour in the middle hollow of each of theſe petals; formed of what would have been the outer coat of the anthera. And even this is ſometimes obliterated.

The form of theſe additional petals is oblong, with ſufficient breadth to give a regular appearance in the flower. Their upper edge terminates variouſly; ſometimes they are pointed, uſually very obtuſe; in ſome flowers wav'd, and in others cut into deep inciſions.

Their ſubſtance and conſtruction ſtill continue what they were in the filament; and differ, tho' not greatly now, from thoſe of the other petals. Each is compoſed of two membranes, ſeparated by a pulpy matter. This is the double Tulip.

The fourth gradation, or ſecond doubleneſs in the Tulip, renders it ſo unlike its firſt, or natural ſtate, and ſo nearly obliterates all appearance of the parts from which the new petals have been formed, that none, unleſs in this courſe of enquiry could ſay whence it had proceeded.

In this ſtate, or the Triple Tulip, there are four ſeries of petals: the two outermoſt are natural, they conſiſt each of three petals, and are what properly conſtitute the flower. The two other ſeries conſiſt of ſix petals each, and theſe are formed by a luxuriance of the filaments, and an obliteration of the anthera, as in the former inſtances: with the additional peculiarity of their being ſplit. This conſtitutes them twelve in number, and as the inner ſix are formed of the anterior ſides of the filaments; they ſtand naturally forwarder than the others: this diſtinguiſhes the twelve into two ſeries. *See Pl.* 4.

To underſtand the conſtruction of this flower perfectly, one muſt go back to the natural ſtate of the filaments; from an expanſion and luxuriance of which, all this doubleneſs is ſtill formed.

We have ſeen in the original ſtate, they are compoſed of a ſolid central part, ſurrounded by a membranous covering. In the firſt ſtate towards doubleneſs in the Tulip, the filament extends in breadth, and this inner ſubſtance loſes ſomething of its thickneſs; in the ſecond ſtage where the

THE TRIPLE TULIP.

J. Hill delin et Sculp

the anthera ſtands in the cleft of the extended filament, this inner ſubſtance is ſtill more reduced; in the third ſtage, where the anthera is a thin line, this ſubſtance is only a kind of membrane uniting the two ſides of the new petal; and fourthly, in this ſtate of tripleneſs it is a mere dot. 'Tis the expanſion of the membranous coat of the filaments which makes the new petals: and the inner ſubſtance has no uſe in this change. It before ſupplied the anthera: that was its purpoſe; and while the anthera remained in the ſecond change, this ſubſtance remained alſo, though in leſs than the original quantity. In the ſucceeding ſtate, tho' it remained in ſome ſmall degree, its uſe and office were loſt; and in this triple condition of the flower being wholly gone, the two parts of the expanded filament, have nothing to unite or hold them together.

THIS third ſubſtance is naturally placed between them, therefore they are not joined to one another by any fibres or veſſels of their own, except at the baſe; and the third ſubſtance which kept them together in the laſt mentioned degree, being now

gone, they ſeparate. Each ſide of the expanded filament becomes a new petal; and thus twelve are added to the flower.

In a ſucceeding year each filament ſplits into three inſtead of two broad petals, and thus forms the Quadruple Tulip; *See Pl.* 5: and one year more makes the perfect full Tulip. In the quadruple kind there remains a ſmall mark of the anthera on each new petal, but in the perfect double flower there is none. *See Pl.* 6.

CHAP. III.

Of Doubleneſs in the Veronica.

SUCH is the courſe and ſtate of doubleneſs in the Tulip: and by this progreſſion it will be perfectly underſtood. So large a flower was ſelected for the illuſtration of the ſyſtem, becauſe the gradations in thoſe obvious parts are eaſily ſeen; and being known in this they may be underſtood alſo in many which are ſmaller. It has been obſerved there are other kinds of doubleneſs ariſing from other parts; but with that ſpecies of the change which proceeds from the filaments, the courſe of natur is the ſame in all.

The

THE QUADRUPLE TULIP.

J. Hill delin et Sculp.

Pl. 6.

THE PERFECT FULL TULIP. *J Hill delin et Sculp*

THE common tall *Veronica*, or Speedwell of our gardens, has a flower as ſmall as any that is cultivated for ornament: but the great number of them, and their regular diſpoſition in the ſpikes, gives them ſome claim to regard; and the celeſtial blue, which is their proper colour, more.

I DON'T know that it had been obſerved, till I remarked it in *Eden*, that the flowers of this plant ſometimes have a kind of doubleneſs. 'Tis a very eſſential article in their beauty: for it not only adds ſomewhat to their ſize, but continues the fine azure colour perfectly through their whole body.

THE flower of the Veronica is placed in a ſmall green cup. It conſiſts of one petal, tubular at the baſe, and cut into four oval ſegments at the top. Theſe are of a fine blue. Within theſe ſtand two filaments: they are naturally long, and towards the top have ſome breadth: they are of a whitiſh colour, and the antheræ which crown them are alſo white at firſt; but when they are burſt, they are yellow.

These parts are plainly ſeen in ſo ſmall a flower: and as the glow of univerſal blue in the ſpike is the true beauty of the plant, this party coloured inſide of the bloom greatly degrades the whole. In flowers too minute to be ſeen at any diſtance diſtinctly, the general good aſpect of the cluſter is what we are to attempt.

This, when the colour is all blue, gives as it were the appearance of one pyramidal flower to the whole ſpike. It cannot be thus in the natural condition of the plant; but accidents we do not underſtand make it ſo ſometimes in gardens: nor does the common eye even while it admires the effect, ſee the cauſe.

In thoſe plants of the Veronica which have ſpikes perfectly blue, the flowers are in a certain ſtate of doubleneſs. It is the ſame degree in the gradation of the Tulip, in which the filaments are expanded into a kind of petals; and the antheræ are wholly obliterated.

The change is leſs conſpicuous becauſe the flowers are in this plant ſo much

ſmaller: and it is indeed leſs in itſelf, becauſe the flower has only two filaments to be the objects of the variation. The advantage however is very conſiderable this way: for the filaments grow near as broad as the petals, and with this change of ſhape, they put off their proper colour. The irregularity they give to the general flower is not regarded; partly becauſe the whole is ſo ſmall as to eſcape ſtrict obſervation; and partly for that the ſegments of the flower itſelf are irregular, the loweſt being narrower than the others.

So much as we have now mentioned, culture ſometimes does without being directed immediately to that end. There can be, ſo far as we yet know, but one degree of doubleneſs beyond what we thus find by accident; and perhaps it is not impoſſible to obtain that by art. The extreme ſtate of doubleneſs in flowers, which owe the increaſe to the filaments, is that each of them having been expanded, ſhould divide or ſplit itſelf into two. If this can be brought about in the Veronica, each flower will be rendered juſt double what it was before; for the new

petals

petals produced from the filaments will equal the four original ones: the ſpike will thus under the ſame ſurface contain twice the quantity of flowery matter, and all will be uniform in colour.

THIS is to be attempted the ſame way as in the Tulip; for there is little difference between the conſtituent parts of that plant and this, except in their dimenſions. Theſe ſmall filaments are compoſed of the ſame matter, and conſtructed in the ſame manner with thoſe larger; and they ariſe from the ſame original part of the plant.

IN the Veronica, carefully diſſected, we find the ſeveral coats of the plant continued from the root to the flower, as regularly and as perfectly as in the preceding inſtance. The outer bark of the ſtalk conſtitutes the cup, and terminates in it juſt as the outer bark of the Tulip does in the three exterior petals of that flower: The ſecond rind forms the flower, and all its parts terminate ſolely there. The ſingle courſe of veſſels terminates in an irregular ring, juſt within the tubular baſe

of

of the flower; the fleſhy ſubſtance runs up into the two filaments; and the pith ends in the rudiment of the ſeed veſſel.

I HAVE traced ſeveral years the progreſs of nature towards doubleneſs in this flower, and have found it paſs through all the ſtages of the larger kinds. Generally the increaſe has proceeded gradually, and regularly in plants, from the ſame root: but ſometimes it has been interrupted, and the flowers have for two or three ſeaſons kept only the ſame degree of doubleneſs; from which they have afterwards advanced farther, or elſe declined to their original weedy and pyebald ſtate. Gardeners have obſerved that ſome years their Veronicas were finer, and ſome years worſe; but they have not gueſſed the manner of the change; much leſs the cauſe.

THE irregularities in this progreſs of the plant towards perfection in doubleneſs, tho' very ſingular, I think may be eaſily explained according to the rules of culture; and if this can be perfectly done, the method of doubling flowers by art, will be then fully known. Of this I am certain

E from

from experience, that a neglected double plant will in three or four years, by degrees, become single. This shews the luxuriance of the parts is owing to nourishment; and we shall from experiments find certainly what part, or what article of culture it is which increases the fleshy substance of the stalk, whereon this change depends; and therefore by that be able to produce it: not casually or imperfectly as it happens now, but regularly, fully, and compleatly.

THE progress of doubleness in the *Veronica* flower proceeds thus in its three stages or gradations; for the fourth or perfect state, tho' I doubt not but the plant is capable of it, we have not yet seen. In the state of nature the filament is whitish, long, narrow at the base, and somewhat broader at the top, and it is crowned with an oblong anthera. In the first stage of the change, or rather in the approach towards the change, the filament becomes broader and more blue throughout. The anthera continues white, but is smaller than before, and the quantity of farina is much less.

IN

Single & Double Veronica.

In the fecond ftage the filament becomes confiderably broader, and more approaches to the colour of the reft of the flower: the anthera is become fmall, and runs along the edge of the broad top of the filament like a thin white line. In the firft ftage it contains fome farina; and in due time it burfts: in this it has none, nor does it ever open.

In the third ftage the filament is yet broader: it approaches to the form and nature of the fegments of the flower, and the anthera is quite obliterated and loft. This is the utmoft ftate of doublenefs yet known in the Veronica; and this is a great addition to its beauty. The reft is to be attempted: and we have befide the grounds of the procefs thus difcovered in the ftructure of the plant, the abfolute proof of contraries, at leaft in favour of the expectation. Experience fhews that a neglect of culture will reduce double flowers to their original fingle ftate; and there is no reafon to doubt but good management will as regularly make the fingle double. *See Pl.* 7. where 1. is the fingle, 2. the double plant; 3. the fingle flower feparate, and 4. the double one.

CHAP. IV.

Of the Degradation of double FLOWERS.

NO one is ignorant that double flowers have been produced originally from the roots or ſeeds of ſingle ones; by accidents favouring the peculiar growth of that part of the plant whereon the doubleneſs of the flower depends. This is plain from the courſe of nature in her productions. For the anthera being obliterated in the third and fourth degree of doubleneſs ariſing from the filaments, there can be no ſeeds ripened in the ſeed veſſels of ſuch flowers. We have ſeen elſewhere, by undeniable proofs, that the rudiment of the future plant is contained in the globule of farina; and that the ſeed is only a ſhell or caſe for its reception, preſervation, and defence. Therefore when there is no anthera, no ſeed can ripen: and conſequently perfect double flowers cannot be raiſed from the ſeeds of plants, with the ſame kind of flowers.

THIS ſhews that in botanical ſtrictneſs, it is right to call the plants with double flowers

flowers VARIETIES of the ſingle, not diſtinct ſpecies from them; but they have ſtretched the point too far, who call them MONSTERS.

As a peculiar degree and kind of nouriſhment given to the roots in a particular manner, has ſwelled and expanded the fleſhy ſubſtance of the ſtalk, and made it in theſe inſtances luxuriant in the filaments, the conſequence of neglect will be a degradation of the flower, as regular as was the riſe to this kind of excellence.

WHEN a Tulip has from favouring circumſtances in the courſe of four, or with interruptions in five, ſix, or more years, been paſſing the ſeveral ſtages to perfect doubleneſs, the filament firſt expanding ſimply, then dividing, the anthera being obliterated in the third ſtage, and the body of the filament ſplit flatwiſe in the fourth; ſo in the ſame courſe of years, or perhaps fewer, with neglect, it will deſcend to its original ſimplicity again; unleſs the ſame good management which favoured the increaſe of the petals continue, and preſerve it.

If a Tulip which has thus attained the ſtate of perfect doubleneſs, be every year taken up at a certain period and planted in good compoſt afterwards, it will continue always ſuch as it appeared when perfect. The bulb is renewed every year; and there is therefore no decay from age. But on the contrary, if the root be planted when thus perfect in common ground, and ſuffered to remain there, the ſoil being neither changed nor dug, tho' it be ever ſo well cleared of weeds, the conſequence will be that tho' the plant retains all its vigour, the flower will yearly loſe part of its doubleneſs. The firſt year the twelve additional petals will be reduced to ſix, and there will be in theſe a portion of that yellow ſubſtance which formed the body of the original filament: The ſecond year the antheræ will appear upon the tops of the ſix additional petals; and thoſe will be narrower and thicker, and leſs colour'd than before: the third year they will differ little from common filaments; and the fourth ſeaſon will afford from the ſame root a common ſingle Tulip.

In the Veronica it is the ſame. Let a plant of it in the beſt ſtate of doubleneſs

we know, be left in an undug border; the ſecond year ſhall ſhew the form of an imperfect anthera upon a pale and ſomewhat narrow inner petal. The third ſeaſon the anthera will ſhew its proper form, and the filament will become narrow and be but little coloured; and the fourth ſummer ſhall produce a common ſingle flower.

WHAT this neglect reduces to its original ſtate, culture has plainly raiſed from that ſtate into the other. That culture can do ſomething towards the producing this change in the Veronica, muſt not be doubted, for this ſeaſon the plant has riſen to the third ſtage of doubleneſs with Mr. *Lee* of *Hammerſmith*, to whom I recommended the care of it when named in *Eden*: and there is a beauty in the flower greatly ſuperior to what has before been ſeen. The ſpike is ſhorter, but the flowers appear in a perfection altogether unknown before: they ſeem as if they were twice as thick ſet as uſual, for each flower having a larger number of petals, appears nearly as big as two. The new petals naturally curl a little inwards; and this has

an advantage: for the inner part of the flower is whitiſh, and would naturally give ſome of that motly aſpect we diſlike to the whole, but theſe new petals hide it by their curling, and the whole is a celeſtial blue.

The attempt to effect theſe changes by a regular culture muſt be thus: the roots muſt be new planted every autumn, and Marle added to the mould. We find this increaſes that part of the timber of trees, which forms the filaments in flowers. Every plant muſt have a yard ſquare of ground, whereon nothing elſe grows; and the ſtalks muſt be annually cut down as ſoon as they begin to flower; watering the root daily for a month after. This fills the bud for the ſucceeding year with the fit nouriſhment.

THE END.

Directions to the BINDER.

Plate *o* to face page 9.—Pl. 1. p. 10.—Pl. 2. p. 22.—Pl. 3. p. 24.—Pl. 4. p. 26.—Pl. 5. p. 28.—Pl. 6. ibid.—Pl. 7. p. 34.

THE
ORIGIN *and* PRODUCTION
OF
Proliferous Flowers.

WITH

The CULTURE at large

FOR

Raising DOUBLE from SINGLE,

AND

PROLIFEROUS from the DOUBLE.

Illustrated with FIGURES.

By J. HILL, M. D.

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M.DCC.LIX.

OF THE

Origin *and* Production

OF

Proliferous Flowers.

PROLIFEROUS FLOWERS are those which have a ſecond, ariſing with a new ſtalk from the centre of the firſt; and ſometimes even a third from this ſecond.

ALL proliferous flowers are accidental: There is no ſpecies which naturally and conſtantly appears in this form. They are variations from the ordinary ſtate of nature, occaſioned by the abundance of a peculiar nouriſhment; and are generally the effect of culture.

MOST flowers muſt be double before they grow luxuriant in a new offspring: but we have a ſingular inſtance of one where the flowers are proliferous to the third degree, and yet ſingle.

THE Compoſite flowers ſometimes produce a ſecondary offspring, but in a peculiar manner; not in the plain way of proliferation: The new flowers ariſe, not from the centre, but round the ſides. The CHICKEN DAISY, and the CHILD-

ING MARYGOLD give familiar inſtances of this; and the laſt ſummer has produced a new one in the Sea Chamœmile.

ACCIDENTS, unknown to the gardener, have hitherto afforded him proliferous flowers; but perhaps 'tis in the power of art to produce them. The philoſopher, by tracing the progreſs of nature ſlowly and ſteadily in this luxuriance, and the gardener, by obſerving carefully what accidents have preceded the appearance of ſuch flowers when they have riſen in his beds, may together lay down a regular courſe of culture for their production.

SOMETHING like this will be propoſed, tho' but imperfectly, in the preſent treatiſe.

As the raiſing double flowers is in moſt caſes an eſſential requiſite to the poſſible production of the proliferous, the full detail of the gardeners management of both was reſerved for this place: the general ſyſtem only having been given in a preceding work *.

MANY plants have occaſionally double flowers from nature or by culture; but the ſpecies are very few in which we have yet ſeen proliferation. It ſeems therefore a difficult operation of nature. There will be the more glory in the ſucceſs if art can give

* Production of Double Flowers.

give affiftance: and this, fince the caufe is plainly in luxuriance from nourifhment, perhaps, under due care, it may.

WE have long been accuftomed to the PROLIFEROUS RANUNCULUS, even to the third ftage; and occafionally ANEMONIES of the fame form have appeared in the florift's borders. To thefe Scotland added a proliferous GEUM; and Germany a ROSE, of the third order: The proliferous CARNATION followed thefe, and clofed the catalogue; till laft year we received from Africa a proliferous PIONY, the product of wild nature.

THE increafe of this kind in compofite flowers is lefs fpecious, and lefs remarkable; but even that is alfo very limited. Befide the Daify and Marygold, we faw only one Hawkweed and a Scabious till the laft year added the Chamœmile to that fhort lift.

SO very fparing is nature in this article; and fo little has art yet added to it. The figures of the feveral known kinds follow; except the Piony, which is too vaft to be reprefented to advantage in this fmall form, where all is of the fize of nature. This I have given in another work *.

THE Ranunculus is the moft frequent of the proliferous kind; it will therefore be

* Exotic Botany.

be uſeful to conſider that plant firſt: And as it naturally grows double before it becomes proliferous, we may advance moſt regularly by firſt tracing its changes to that ſtate.

CHAP. II.

Of the Ranunculus *or* Crowfoot.

IN the common Crowfoot; or ſingle Ranunculus of our meadows, the flower is thus form'd. A cup of five leaves terminates the ſtalk; and within this are placed five broad petals or flower leaves, with ſmall baſes, and a cell or hollow dent, open or cover'd near the bottom: This cell Linnæus has named the Nectarium. Above ſtand numerous filaments, and from amidſt theſe riſes an oval head, which is a receptacle of ſeeds, cover'd on the ſurface with rudiments of them. The ſingle garden Ranunculus, tho' a native of Aſia, differs little from this in the conſtruction of the flower: and it is from that ſingle Aſiatic kind we are to trace the courſe and progreſs of the change, firſt to a double, and thence to a proliferous ſtate.

In the ſingle Aſiatic Ranunculus there uſually is a petal more than the proper number.

number. One of theſe flowers is repreſented, Pl. 1. Fig. 1. cut upon to ſhew its conſtruction. It is frequently yellow in this ſtate, but as it grows double it becomes tinged with ſcarlet; and is at laſt ſcarlet entirely.

THIS change of colour is more extraordinary than the common variations of red or blue into white; but it is not ſingular in the Ranunculus. The native and original tulip is yellow, yet red is common in our gardens; and in the Impatiens we ſee the fair gradation.

THE ſtalk of the Ranunculus, as in other plants, is compoſed of two rinds, a Blea, a fleſh, and Pith. The outer rind of the ſtalk terminates in the cup but the inner rind, the Blea, and the other parts continue their courſe higher. Theſe ſwell into a greater thickneſs in the Place where the petals riſe; and thence the body which they form gradually diminiſhes a little upwards. So that upon the ſummit of the ſtalk is ſeen a ſwoln part of a pearlike ſhape, with the broad end downwards, Pl. 1. fig. 1. *a. b.*

This is hollow within, and it is truly the ſtalk of the plant continued intire in that form, except for the want of its outer rind.

THIS pear-ſhap'd body is continued in a ſlenderer form upwards, hollow as the other;

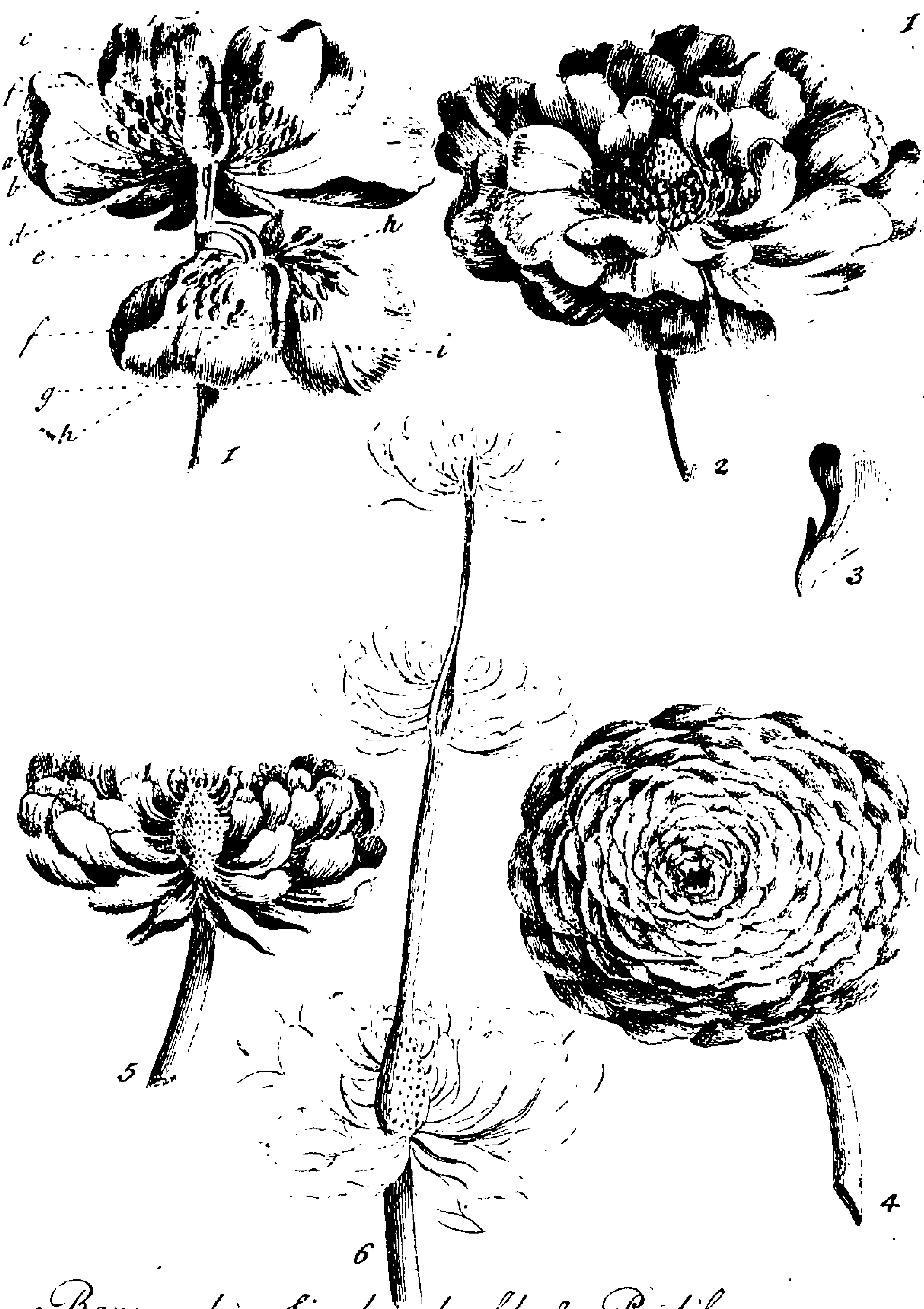
other; indeed making one continued hollow with it, and with the ſtalk; and at the top it terminates in a rounded and cloſed end *c*.

The ſtructure of this part is beſt ſeen by cuting in two a flower of a ſingle, or nearly ſingle Ranunculus; together with a piece of the ſtalk. Thus we may trace the mechaniſm of the head, and that will lead us to underſtand the manner wherein the flower becomes firſt double, and then proliferous.

The ſtalk diveſted of its outer rind at the cup, is thus continued with its natural hollow up to the top of the receptacle or head of ſeeds; but the cavity is larger here than in the ſtalk itſelf.

Tho' the whole head or receptacle with its two parts, the lower pyriform, and the upper cylindric, be a continuation only of the ſtalk of the plant, and indeed its natural termination; yet for the more clearly comprehending the ſtructure of the flower, it will be uſeful to diſtinguiſh that part by different names in theſe its ſeveral ſtages. Thus what we call abſolutely the Stalk riſes from the ground and terminates at and in the cup *d*. The pear-ſhap'd part we ſhall call the receptacle of the Flower *e*; and the cylindric, or uppermoſt portion of this, the Recep-

TACLE



Ranunculus Single double & Proliferous.

TACLE of the SEEDS *f*. By theſe names we ſhall diſtinguiſh the ſeveral portions eaſily and perfectly.

FROM the receptacle of the flower *e*, riſe the petals *g*, and above theſe the filaments *h*. From the other part, or upper, ariſe the rudiments of ſeeds *i*, crowned each with its ſtigma, without a ſtyle. This is the natural ſtate of the Ranunculus flower: the petals are only five or fix; and the filaments are in a manner innumerable. Theſe riſe from the ſame receptacle with the petals themſelves, and are of like ſtructure: compoſed of the ſame parts, tho' different in form: the petals being broad and flat, theſe filaments rounded and ſlender; and each of them terminated by an oblong double anthera.

THE firſt change which culture produces in this plant is the rendering it double, Pl. 1. fig. 2. and 4. After this, if at all, riſes the farther luxuriance, making it proliferous.

THE doubleneſs of the flower is produced by the filaments ſwelling in breadth, and thus becoming petals. This is performed exactly as in the Tulip: Inſtances of which have been given in all the ſtages in a preceding treatiſe. In the double Ranunculus we ſee the filaments diminiſh

in

in number as the petals encreaſe; and the curious obſerver by looking over a bed of theſe plants when in flower, and examining the more and leſs double ones, will find, that the additional petals in thoſe which are leſs double, are as yet irregular in ſhape. He will ſee the remains of the anthera in its proper place upon them; tho' the body of the filament has ſwelled to twice its natural length and breadth behind it, forming a kind of petal. Pl. 1. fig. 3.

As the flowers grow more compleatly double theſe petals acquire more nearly the form of the others; and the remains of the antheræ then diſappear intirely.

Thus there are no filaments or antheræ in compleatly double flowers: but this is not all the change. While theſe parts have been gradually ſwelling into abſolute petals, the receptacle of ſeeds has been by degrees diminiſhing: and when a flower is perfectly double, that part alſo totally diſappears. Pl. 1. fig. 4. The receptacle of the flower having ſuch an unnatural multiplicity of petals to ſupport, the nouriſhment has all been detained there; and as rudiments of ſeeds would be uſeleſs where they could not ripen for want of antheræ, nature has left no place of reception for them.

Thus

THUS is form'd the double Ranunculus from the ſingle: abundant nouriſhment of a proper kind expanding the filaments into petals.

WE are next to enquire how prolifera-tion, the utmoſt ſtage of luxuriance, is performed.

THE ſtalk of the plant which is con-tinued thro' the head of the flower, Fig. 1. *b c g f*, terminates naturally in the obtuſe top of the receptacle of ſeeds *c*. But this is not well ſeen unleſs the flower be cut open; becauſe the top as well as ſides of this receptacle are in a ſtate of nature ſur-rounded with rudiments of ſeeds, whoſe purple and rough ſtigmata, cover the whole with a kind of down.

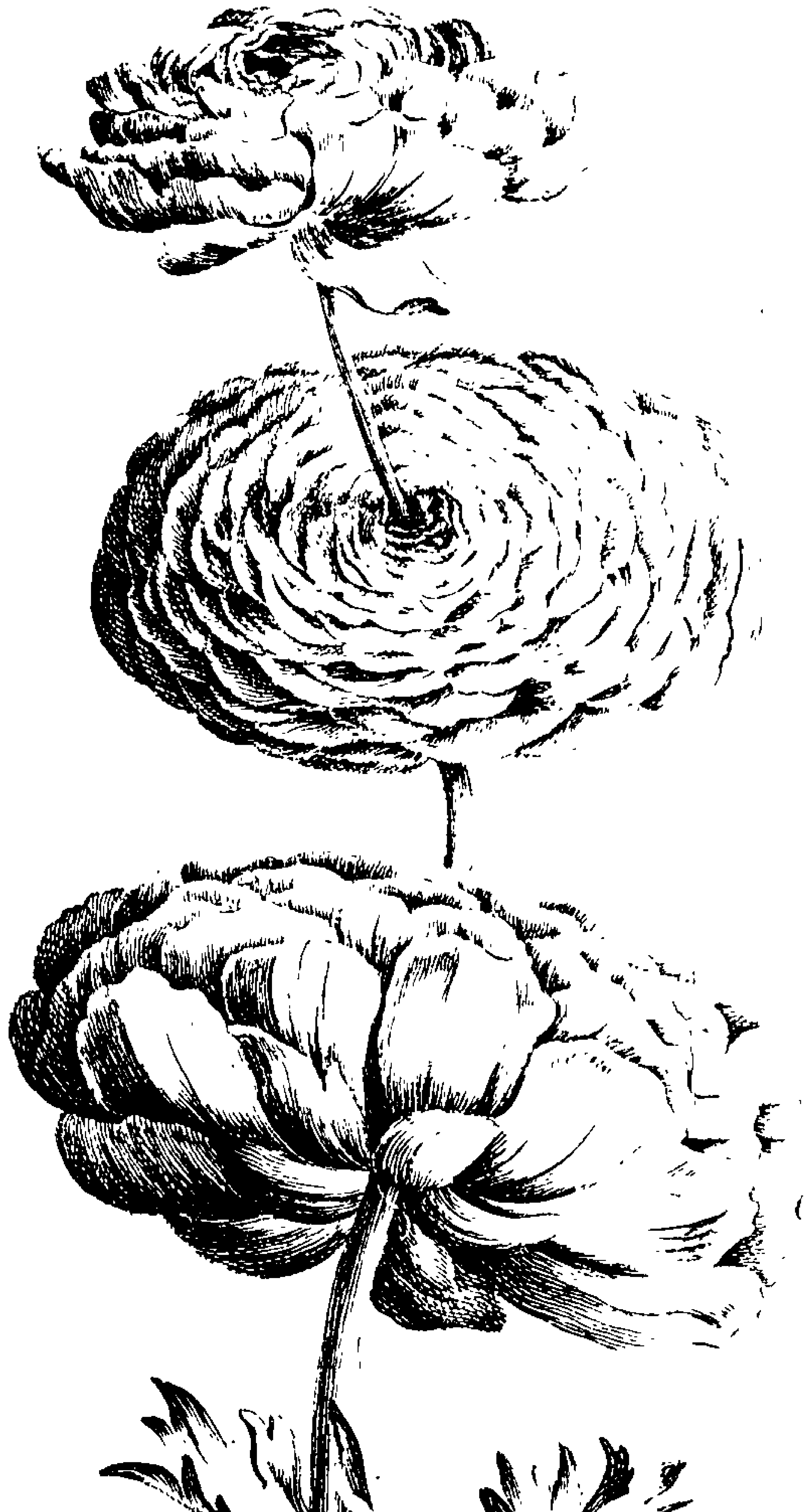
IN every double flower the receptacle of ſeeds is wanting; and in theſe the ex-tream end of the ſtalk is ſeen in the top of the receptacle of the flower, where it either terminates in a multitude of very minute petals (Pl. 1. fig. 5.) or in a plain round end 4.

WHICH ever be the caſe, when the flower is cut open, the hollow of the ſtalk is ſeen to continue regularly up ſo far: and there it naturally finiſhes. But when extream luxuriance puſhes the growth yet farther, this is the ſeat and ſource of the encreaſe; and gives proliferation. The

ſtalk inſtead of terminating thus in the center of the flower grows up out of it; riſes to an inch or more in height; and bears upon its ſummit another flower perfectly like the firſt. Even from this ſecond flower, in the higheſt ſtage of perfection, there riſes in the ſame manner a third. Pl. 1. fig. 6.

THUS is the triple crown of the Ranunculus form'd; and 'tis a very elegant and pleaſing effect of culture. Pl. 2. The ſecond flower in this caſe has a cup; but it is leſs perfect than in the firſt: In the third there remains nothing of this part except a thickned and greeniſh back upon two or three of the loweſt of the Petals. Each flower in ſuch a plant conſiſts only of petals fix'd to their proper head, without any receptacle of ſeeds.

IN all theſe flowers the aditional petals formed of filaments may be diſtinguiſhed from the natural ſix at the bottom: for they have thick hollow baſes; whereas thoſe of the proper and original petals, tho' they be narrow, yet are thin, flat, and ſolid.



Triple crownd Ranunculus.

CHAP. III.

Of the ANEMONE.

THE ANEMONE has no cup. The leaf upon the ſtalk ſerves its office while the flower is in the bud; and afterwards the three outer petals become ſo firm, and are ſo well fixed, that no more defence is needed.

EXCEPTING this want of a cup, the ſtructure of the ſingle Anemone is not very unlike that of the Ranunculus: but its doubleneſs is produced in a manner perfectly different.

THE flower of the ſingle Anemone is compoſed of ſix petals, placed in two ranges: the exterior three are formed of the outer rind of the ſtalk, as is the cup of the ranunculus: the inner rind makes the three inner petals; and the reſt of the ſtalk is continued in a receptacle for the filaments and ſeeds.

THE receptacle of the filaments is oval, and that of the ſeeds is ſomewhat conic. This laſt takes its origin from the top of the former, and is one continued ſubſtance with it. The diminution of the receptacle of ſeeds from that of the flower, is leſs in this plant than in the ranunculus:

culus: ſo that the whole may be ſaid to form one oblong oval body. The diſtinction of theſe parts is however eſſential; tho' it be leſs ſtrongly marked in this ſubject: and altho' it ſcarce appears externally, it is very obvious in the flower when cut open.

THE moſt proper kind of Anemone for this purpoſe is a ſingle one, which has ſtood till the petals are ready to fall. 'Tis from this ſingle ſtate, we are to trace the doubleneſs, and proliferation; and in a flower which has ſtood ſo long, the receptacles or head will be grown up ſufficiently for that purpoſe.

TO the receptacle of the flower are fixed the three inner petals, and juſt above them riſe an innumerable multitude of filaments, as in the Ranunculus: but they are as ſlender as hairs in this plant. Their antheræ are alſo doubled.

THESE cover entirely the receptacle of the flower, but they reach no farther. From the upper part of the head, which we call the receptacle of the ſeeds, riſe the rudiments of thoſe ſeeds: They ſtand cloſe all over it; and they are crowned with ſmall ſtyles, on which are blunt ſtigmata. This is the ſtructure of the ſingle Anemone.

IN

In the Ranunculus we ſee the filaments become petals, in order to form the doubleneſs; and the receptacle of ſeeds is then obliterated: but in the Anemone the filaments are too ſlender for this office. The additional petals in this plant are formed from the coats of the young ſeeds.

This is the courſe of nature: and for this reaſon we ſee three parts in a double Anemone, tho' but two in the double Ranunculus. In that flower, excluſive of the cup, there are only the natural outer petals, and the inner ones which have been formed of filaments: but in the Anemone there are firſt the two ranges of outer petals; ſecondly the ſeveral ſeries of filaments, which are a little alter'd in form and colour, but are not converted into petals; and thirdly the additional petals, which make the doubleneſs, and which are formed out of the rudiments of the ſeeds.

The filaments are altogether diſtinct from theſe. They are ſhorter and narrower: and they retain, in ſome degree, even the form of their antheræ, tho' the uſe of thoſe parts be loſt.

Thus is the double Anemone form'd: And the proliferous riſes in the ſame manner from it, as from the Ranunculus. The termi-

termination of the ſtalk in the double Anemone is in the ſummit of the receptacle, which in thoſe flowers never runs up into any conſiderable length; and it there naturally finiſhes in a cluſter of of very minute, and imperfect petals; ſomewhat open, or elſe compact as a button; formed of thoſe rudiments of ſeeds which covered it.

When the extream luxuriance of culture forces a farther growth after all the rudiments of ſeeds are converted into petals, this part is again the ſcene of it. The extream end of the ſtalk grows up, riſes out of the flower, and aſcending two inches above it, bears upon its head another flower, perfectly like the firſt. Pl. 3.

This is the origin of the proliferous flowers in the Ranunculus and the Anemone: It contradicts the modern philoſophy, which ſays *proliferation is from the* Pistill. For if it were ſo, there muſt be as many new flowers in the proliferous Anemone, and Ranunculus, as there are rudiments of ſeeds.

Proliferation is indeed in theſe flowers a very ſimple proceeding. It is not the changing of one part into another, but the mere continuing of the ſtalk to grow, thro' the body of the flower. It

would

Imperial Anemone.

would not be ſtrange to reaſon that this ſhould be more common. The termination of the growth of plants, at the flower happens only becauſe ſeeds are formed there: In theſe double flowers no ſeeds are produced; therefore the uſual cauſe does not obtain. The occaſion that this ſecond growth is leſs frequent, is the great degree of fullneſs in theſe double flowers: as much nouriſhment being perhaps required for them, as would be for the ſeeds.

CHAP. IV.

Of the proliferous GEUM.

THIS very peculiar plant, which is often proliferous in the wild ſtate of nature, will confirm in ſome degree the obſervation made at the cloſe of the laſt chapter; for it becomes proliferous without being double. This luxuriant ſtate of it, which nature offers, is indeed uſually but imperfect in our country: but there are places where 'tis vigorous and elegant. With us the production of a ſecond flower, and that ſcarce able to expand its petals, is all that we find wild; but on the Pyrenæan mountains nature

nature often raiſes the flower to the third ſtage perfect, and yet keeps all ſingle.

GEUM is a name which the new Botany gives to the plant before called, from the ſpicy flavour of its root, CARYOPHYLLATA. The ſpecies which becomes proliferous is native of our northern counties; and in the place of the little yellow and fugacious flower of the common kind, this has it large, permanent, and purple. 'Tis called *purpurea* from the colour of the flower, and from the place of growth ſometimes *montana* and *paluſtris*: it demands both epithets, for its moſt favouring ſeat is at the edges of thoſe bogs which are upon the tops of hills.

THE flower is naturally not unlike the Crowfoot. It has a divided cup, and in the ſimpleſt ſtate has only five petals, with numerous filaments, and as numerous rudiments of ſeeds, covering a ſhort blunt receptacle. In this ſtate 'tis common in the upland bogs of *Yorkſhire*; and as frequent in *Wales* and *Ireland*.

WHERE the nouriſhment is any thing luxuriant, the petals encreaſe in ſize and number: Eight uſually take the place of the original five; and they ſpread out more flat.

THE next redundance is uncertain; for it depends on the nature of the ground.

If

If the mould be rich but ſhallow, as is the caſe upon the ſides of our hills in *Weſt-moreland*, the filaments form petals; and the flower grows regularly double. It becomes then globular as the Ranunculus of our gardens: But where the ſoil is deep; and is moiſt alſo to the bottom, as 'tis in the high boggs of *Scotland*; and on the weſt parts of the *Pyrenæan* mountains the flower becomes at once proliferous, without any farther doubling than a ſmall encreaſe of its ſingle or natural range of petals.

THE figure here annexed is from a Pyrenæan plant; and theſe were its exact dimenſions. Sibbald in Scotland long ago ſaw ſomething like it.

IN this ſpecimen the petals of each flower were eight; they were large, waved, and ſpread out flat; reſembling more the DRYAS than the GEUM. The filaments held their place unaltered; but the ſtalk of the plant, inſtead of terminating in a receptacle of ſeeds, grew through the firſt flower, and at ſome height above produced a ſecond: then, growing thro' that alſo, it bore on its ſummit a third, in which the receptacle of ſeeds was perfect.

THE facts are certain as to the places of growth of the plants which have theſe ſeveral redundances; and this will lead us

one ſtep towards the great article of raiſing ſuch flowers by culture. Mr. LAWSON, celebrated in the Engliſh botany, found this purple GEUM with four or five ranges of petals, near GREAT STRICKLAND in WESTMORELAND; and long before him Mr. BREARCLIFF in a wood on an eſtate of his own name. In both theſe places the ſoil is rich but ſhallow. The Scotch bogs, about whoſe edges SIBBALD found the ſame plant, are generally compaſſed with a deep black mould, ſuch as that of our Engliſh fens: and finally the place where the plant was gathered, from which this figure is taken, Pl. 4. was moiſt and mellow, to a depth beyond the full length of a French walking-cane. The leaſt particularities in nature are to be regarded: the rational aſſiſtances of art depend on them entirely.

CHAP. V.

Of the Proliferous ROSE.

FOUR of the five properly proliferous plants are of the POLYANDROUS kind. The character of this claſs is that the filaments are numerous, and ariſe from a receptacle; not from the cup or petals of the flower; as they do in ſome others which


Pyrenæan Geum.

which have alſo great numbers of them; and are thence ſeparated under the term Icoſandrous.

THIS is a particularity that demands notice. We know the filaments are formed of the eſſential part of the plant, that is the fleſhy ſubſtance in the ſtalk. And we ſhall find on a proper ſearch the receptacle in theſe peculiar plants has alſo a portion of this fleſhy ſubſtance; but the blea forms the greater part of it.

The natural termination of the fleſh of the ſtalk is in a vault or arch which makes the top of the receptacle. When this arch is form'd at that place, the blea ceaſes to extend itſelf in height; and there it terminates the plant. But if the blea can, by art or nature, be puſhed up farther than this its general termination, the fleſhy ſubſtance will accompany it; and when it has aſcended an inch or ſomewhat more, a new flower will be there form'd; and it will in this ſtate finiſh in that flower. The receptacle in this plant, tho' imperfect in the lower flower, will be natural and entire in the upper one.

THUS is form'd, and thus perfected, PROLIFERATION IN ONE STAGE. If a farther redundance of peculiar nouriſhment continues to puſh the blea yet farther, the ſame courſe will be obſerved by

nature,

nature, and a third flower will be formed upon the ſummit of another portion of the ſtill aſcending ſtalk.

FARTHER than this I have not ſeen proliferation reach: The wonder is, that it can go ſo far.

THE root of every plant has a peculiar force of imbibing; and of propelling upwards the juices which it obtains from the earth. On this depends the height of the ſtem: for where that force ceaſes, the flower is form'd.

WHEN the juices can be carry'd no higher, the parts which would grow into leaves unite and make a cup; and the other conſtituent parts of the plant ſtop in the ſame manner, and terminate in the ſame place; forming the various portions of the flower. This is the ſyſtem of FLORESCENCE; and on this depends doubleneſs: for if any accident of culture, or abundance of wild nouriſhment of a right kind forces out the flower below the proper ſtandard of growth, I have obſerved that it becomes uſually double. This happens becauſe 'tis better ſupply'd than it would have been at the extream height of the ſtalk.

WHATEVER nouriſhment encreaſes particularly the fleſhy ſubſtance of the plant gives it a tendency to burſt thus early

early into flower; and to extend the filaments into a kind of petals: and in the same manner whatever peculiar nourishment feeds the blea, in a like manner forces up that part, even after the flower is formed: and thus is produced proliferation.

THESE are not useless researches: the the more we know of the real nature of the change, the better we shall understand how to promote it at our pleasure.

THE ROSE often approaches to proliferation; but we rarely see that change perfected. When the encrease is compleat no vegetable has it so elegantly. In the Geum, just nam'd, and in the Carnation, to be described hereafter, the upper stalk, placed between flower and flower, is naked: but in the Rose, when perfectly proliferous, it has a leaf upon it, like those upon the young shoots of the same shrub.

THE blea is plainly in this, as in the other instances the part which ascends from the centre of the original flower: for the natural outer rind has terminated in a cup; and the inner rind in petals. Yet this ascending blea does not continue naked: it forms itself first an inner rind from its own substance, and then an outer bark from that. Those integuments, and even the blea itself, were originally thus formed in the seedling plant, for the

Co-

CORCULUM or heart of the ſeed burſts from its covering naked; and as it ſwells for growth, forms theſe parts for its covering.

IT is a great deal for the ſtrength of nature at that height of the ſtalk which a forced nouriſhment has form'd above the proper flower, to furniſh out theſe Coverings for the blea: but in the plants juſt named it does no more. In the Anemone ſometimes a jagged film appears upon the ſtalk between the flowers, but in the Roſe, often a perfect leaf.

THIS being a hardy ſhrub has longer fibres, and a more vivid blea than the herbaceous kinds; and thence has this preeminence.

PECULIAR ſeaſons favour the exuberance: but there muſt be alſo ſutable ſoils to render the flowers perfect. The laſt ſummer was one which tended to this elegant production, and I ſaw ſeveral in the Engliſh gardens; but all far from perfect. The beſt was one at Mr. WARE's on WESTBOURN-GREEN, but the proliferation was but of one ſtage; and the upper flower a very poor one.

THE ſpecimen repreſented in the annexed figure I received from Germany, with the ſpecious name of REX ROSARUM King of the Roſes, or the ſovereign Roſe. See Pl. 5.

THE

Sovereign Rose.

The ſtalk on which the original or lower flower grew, differed in nothing from that of common roſes. The ſecond was ſupported on a new ſtalk, formed by a ſingular continuation of the firſt; and the third in the ſame manner on a new ſtem a continuation of the ſecond. All three were perfect, and the ſtalks between ſo vigorous as to have leaves.

In the inſtances hitherto examined the new ſtalk has been always form'd by a continuation of the receptacle of ſeeds raiſed within the flower; but in the Roſe there is no ſuch receptacle. The branch ſwells at its extremity into a peculiar kind of fruit; within which, not upon its ſurface, are placed the ſeeds; and from whoſe ſummit, not from its baſe, riſes the proper cup of the flower: The petals and the numerous filaments having their place within.

The doubleneſs of the Roſe is made by ſome of the filaments ſwelling into petals; and in the perfect full kinds all of them undergo this change. The inner part of this fleſhy fruit is form'd of the pith of the ſtalk, and this has for its covering the extream part of the fleſhy ſubſtance, over which lies the blea. The fleſhy ſubſtance naturally breaks into filaments at its extremity: but if abundant nouriſhment

ment of a proper kind forces the blea to aſcend higher than the body of the flower, a part of this ſubſtance always accompanies it; and new coats are formed on that, as ſoon as it is expoſed to the air. Thus a new ſtalk is produced with all its parts, ſupporting a ſecond Roſe; and in the ſame manner afterwards a third.

CHAP. VI.

Of the Proliferous CARNATION.

THE Carnation is a ſingle inſtance, ſo far as I have ſeen or heard, of a regularly proliferous plant, which is not of the polyandrous tribe. This however comes near to that claſs in place, tho' it does not enter it. 'Tis one of the DECANDRIA, and has numerous filaments in the natural ſtate, tho' they be not ſo abundant as in thoſe other plants: perhaps therefore the proliferation happens rarely.

THERE is ſomething peculiar in the manner wherein the Carnation becomes thus redundant in flower; for it has not that part from whence the new ſtalk is formed in the preceding inſtances. The ſeeds in this plant are not fixed to a receptacle, but lodged in a capſule: and as it is the receptacle which becomes extended into a new ſtalk in thoſe kinds, it is

is the rudiment of the capſule or ſeed veſſel which furniſhes the matter of the change in this.

IN the CLOVE-JULY-FLOWER, from which this Carnation is raiſed by care and ſuperadded culture, the ſtalk is carry'd entire to the baſe of the cup. There its outer rind makes the four ſcales at the bottom, and terminates in them: The inner rind forms the long tubular cup of the flower, which gardners call the pod of a Carnation: The blea makes the petals; and the fleſhy ſubſtance terminates in the filaments, except that a ſmall portion of it covers the body of the new form'd capſule, whoſe principal ſubſtance is a termination of the pith.

THIS is the natural ſtate of the flower. The rudiment of the ſeed veſſel, whoſe origin is from the pith and a portion of the fleſhy ſubſtance only, gets itſelf new coverings even in the flower, analogous to thoſe it loſt by their going off in the petals, and the cup: If we cut a young ſeed veſſel tranſverſly, we ſee them all tho' very ſmall in quantity. They terminate at its ſummit in this natural ſtate of the bloom; but abundant nouriſhment may, as in other inſtances, extend them higher: and in that caſe a ſecond flower is the natural and neceſſary conſequence.

The change in the Carnation proceeds just as in the Ranunculus, the Tulip, and the like, so far as doubleness is concerned: An abundant nourishment of the fleshy substance connects the little filaments into broad petals: ten are thus added to the flower; and afterwards by their spliting flatwise often twenty.

If there be still redundant, rich, and proper nourishment after this, the farther growth gives proliferation. It is perfected thus.

The fleshy coat of the young seed vessel forming itself fresh coverings in the flower, the first and nearest to it is a new blea. This is there coated with its two rinds; and instead of terminating in a kind of arch at the top of that rudiment, it grows upwards; rises from the center of the flower its natural bed; and taking with it a portion of the fleshy substance within, and its two coats without, the whole thus becomes a new stalk.

The plant had before reached its due natural stature; and the tendency it then had to flower still continues: so that at a small height the parts arrange themselves for flowering a second time, just as they did below. They are all of them seen distinctly in this upper stem, as well as in the lower, and therefore, if nourishment enough rise,

this

Supream
Carnation.

this flower alſo will have all its parts, and be perfect. The ſpecimen whence this figure was deſigned, had them truly ſo: the upper flower had all the parts of the lower, and one more; for in it was a rudiment of a ſeed veſſel: there were fewer petals in this flower than in the lower, but that is not eſſential. See Pl. 6.

The plant was raiſed in Italy, and ſtood in an open border, as did alſo another, like this but inferior, which flowered in the ſame garden in the year 1753.

CHAP. VII.

Of the Chicken Chamoemile.

THE Daisy, when it has been raiſed from its plain ſtate to doubleneſs, and to proliferation, has been reſembled with its little ſideling brood to the hen and her new hatch'd young ones. This Chamœmile may retain the name; as it has perfectly the form and nature of that pretty plant, in the whole compoſition of its flower.

The ſenſe of the term proliferation juſtly admits this ſpecies: for new flowers are produced from the ſame baſe with the old; but they are diſpoſed altogether differently; Theſe ſyngeneſious plants are a peculiar tribe: each flower in them is properly a cluſter,

cluſter, or congeries of many; tho' one cup holds them. The yellow tubular floſucles which make the center in this Chamœmile, and others, in the ſtate of nature are ſo many perfect little flowers: Each has its filaments and rudiment of fruit: and even the rays at the verge, tho' very different in form, approach to them in nature. Each of theſe has the rudiment of a ſeed which is to be impregnated from the farina of the others.

The original flower whence culture has now raiſed this elegant redundance, conſiſts of a great yellow head ſurrounded with a ſingle ſeries of white rays; the yellow head being compoſed of tubular floſucles.

The method wherein this flower becomes doubled is exactly the ſame with that of the other compoſite kinds, which I have given at large in a late work *: The yellow and tubular floſucles becoming white and flat by an eaſy and gradual change. Each of theſe is originally form'd of one petal, cut at the end into five ſegments: and within it ſtand five filaments, with coaleſcent antheræ.

When luxuriant nouriſhment urges the growth of the flower beyond the intended limits, one of theſe five ſegments extends itſelf

* Exotic Botany.

itſelf firſt, beyond the reſt in length, and becomes whitiſh at the end. In the next ſtage this enlarged ſegment of the yellow foſcule becomes yet longer, and takes into its ſubſtance the two others which are next it. 'Tis then plainly white: the filaments fade within it, becauſe the nouriſhment goes to this part; and the floſcule becomes a mongrel, of a middle nature; being neither altogether flat nor wholly tubular; nor altogether white nor entirely yellow. The next ſtage lengthens it yet ſomewhat more; it becomes entirely flat, plain, and white; and is like altogether to the original verge of petals, round the flower, only ſhorter. Theſe new petals lie like ſcales, in many ranges, one beyond another; and the flower being of a ſnow white, and from the multitude of the new petals, almoſt globular, it has a fine appearance.

Thus is the double Sea-Chamœmile of the Engliſh Gardens form'd from the wild Italian plant, whoſe flower hardly exceeds the coarſe aſpect of our common May-weed. But this is not all. Redundant nouriſhment, a depth of ſoil, and ſea-weed for manure, have raiſed it this laſt ſummer, in Lincolnſhire, to a new perfection; rendering it, in its way, proliferous.

From

FROM the full double flower in this new ſtate there ariſe no leſs than ſix of the proliferous order. They take their origin, not from the centre, as in the kinds juſt nam'd, but from the ſides; and tho' they very exactly reſemble the original flower, they are but diminutives.

ONE rounded cup contains the many floſcules which compoſe the original flower; and theſe miniature productions riſe from the ſwelling at the ſummit of the ſtalk juſt within that cincture: each with its own ſmall footſtalk. In the entire plant the outer rind having form'd the cup, there terminates: Theſe footſtalks of the new flowers therefore riſe diveſted of an outer coat; but this is a part as eaſily producible in plants as the outer ſkin or cuticle in animals: the young ſtalks ſoon get that additional covering; and there is nothing to prevent their terminating as the reſt in perfect flowers; only that full nouriſhment is not eaſily convey'd to ſuch a numerous and diſtant progeny. See Pl. 7.

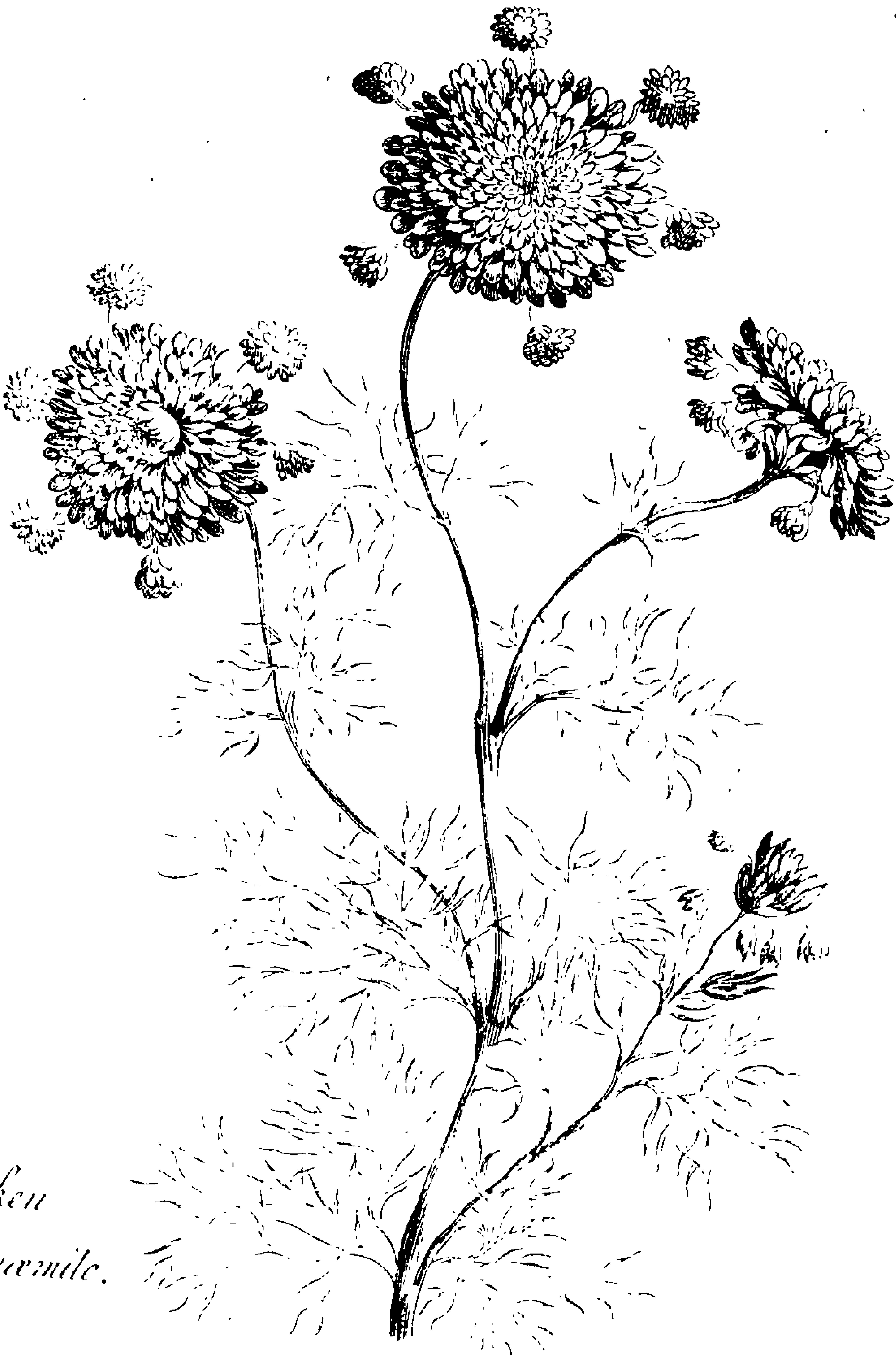
CHAP. VIII.

Of the Production of LUXURIANT FLOWERS *by Art.*

I. THE SYSTEM.

WE have thus traced with ſlow and cautious ſteps the courſe by which the

7



Chicken
Chamomile.

the encreaſe of flowers is form'd, whether in doubleneſs, or proliferation: and the enquiry into thoſe peculiar circumſtances which attend theſe productions when they are the work of nature, will lead us by a plain detail of reaſon toward the means thro' which the ſame encreaſe may be rationally attempted by art.

ADVANCES in theſe paths are very ſlow. Gardening, which is a ſubject equal to the moſt exalted philoſophy, is in the hands of ignorant men, and little underſtood: Certain knowledge is therefore difficultly attained, in whatever has concern with culture. Yet under all theſe diſadvantages the ſearch of truth has been continued, at my inſtigation, in different parts of the kingdom, and ſeems to promiſe fairly toward our encreaſing the number of double and proliferous flowers.

THE general method, and the great firſt material I have given in a preceding work *, not being able then to go farther. The reſult of ſeveral of the trials had not then been tranſmitted me; and 'tis not a ſubject on which to indulge conjecture. Diſcoveries, tho' ever ſo imperfect, have their value; but fancy and vague gueſs would render all confuſion.

THE

* On double flowers.

THE principles are theſe. Of the five ſubſtances which conſtitute an entire plant, two only are concerned in the doubleneſs and proliferation of the flowers here conſidered. Theſe are the blea and the fleſhy ſubſtance; the third and fourth parts, counting from the ſurface. The fleſhy ſubſtance breaks into the filaments, which, when they become luxuriant, form petals, and occaſion doubleneſs: The blea, when it is made redundant, riſes into a ſtalk beyond the flower, and gives proliferation.

THE luxuriance of the fleſhy ſubſtance is owing to an encreaſe of nouriſhment: and ſo is the redundance of the blea. But an encreaſe of general nouriſhment affecting all parts equally, only enlarges the entire plant.

THERE are peculiar ſoils which encreaſe particular parts of vegetables, and they muſt owe this to particular ingredients.

IN ſome parts of Northamptonſhire the ASH grows ſo tall and fine, that the moſt incurious cannot but obſerve it. On examining ſome of theſe trees when fell'd, I found the blea bore an over proportion to the reſt of the parts; and that it had obtain'd alſo a peculiar cloſe and even ſtructure. A well which was then diging in the neighbourhood, gave opportunity of examining the ſoil. The upper coat

of

of mould was not deep: a broken ſtratum of ſtone lay under that, and beneath this a bed of a looſe clay. Under theſe three lay a ſtratum of vaſt depth, moiſt, mellow, and full of the remains of vegetable matter; ſuch as we ſee in bogs; but mouldering to duſt: this, tho' moiſt, was not abſolutely wet; and it was encompaſs'd with an abſolute fenny mould. Into this peculiar bed of earth I found the *Aſh* roots penetrated; and doubtleſs 'twas to that accident the encreaſe of blea was owing.

THIS opinion is ſtrengthned by the deep Scotch ſoil, which makes the Geum proliferous in wild nature; and as we know an encreaſe of blea gives additional height in that plant, 'tis probable from the ſame cauſe, the *Aſh* trees are in this place tall, as well as ſwell'd with this thicken'd ſubſtance.

THE Beach in Suſſex has a peculiar excellence, as the *Aſh* in that other county; but it conſiſts in a different article. The tree is no taller than elſewhere, but the *wood* is more in quantity and better. The blea is leſs in quantity in the Suſſex Beech than in that of Buckinghamſhire, but the wood is encreaſed and rendered finer. This is not univerſal in the county: the late Duke of Richmond was curious to exa-

mine the timber in many places, and I had the honour to attend him : in ſome we found it thus particularly fine ; in others not : The cauſe did not occur at that time, but by enquiries ſince, I find wherever the BEECH was thus improved there was MARLE in the ground : Where that was wanting, there was no ſuch excellence. We thus ſee the ingredients in a ſoil can occaſion this encreaſe ; and this being ſufficient, it were vain and idle to ſeek any other cauſe : at leaſt this has a title to be received as the true, till we know a better; and thus far we have a right to reaſon by induction.

THE parts of tender plants are the ſame in number and in nature as thoſe of trees, only they are leſs firm. The outter and inner rind of an herb anſwer to the exterior and interior bark of a tree. The blea has the ſame name in both, as well as the ſame nature : The fleſh or fleſhy ſubſtance of the plants ſtem, anſwers to the wood in the trunk of the tree ; and the pith is the ſame in both.

TREES and plants are capable equally of having one or other of their conſtituent parts encreaſed by certain kinds of nouriſhment : We ſee what ſoils produce the effect with certainty in trees ; and it is highly probable the ingredients which give

them

them that power will do the ſame in plants; for the ſame cauſe produces naturally like effects. This alſo experience ſeems to confirm; but the trials muſt be more than the time has yet allow'd.

As proliferous flowers are uſually produced from double ones; to raiſe a plant to doubleneſs ſhould be the firſt ſtep towards proliferation. And our endeavours toward this laſt point will ſucceed beſt when we ſelect a plant juſt raiſed by art to perfect doubleneſs. For tho' proliferation depends immediately on the blea riſing beyond the flower, yet there is a neceſſity the fleſhy ſubſtance of the plant accompany it; and this will be moſt eaſily obtain'd, while that ſubſtance is itſelf newly made luxuriant. On this foundation it may be rational to make the attempt by the following method of culture: ſelecting the Geum as a plant in which the native principles of doubleneſs and proliferation both are ſtrong and capable of exerting themſelves even in wild nature. Marle encreaſes the wood in trees, and a deep vegetable ſoil the blea. When the firſt of theſe parts is encreaſed in plants, doubleneſs follows; and when the latter, proliferation: Therefore theſe ſubſtances added to a ſoil by art, and aſſiſted by the full effect of a good culture, will probably al-

ways,

ways, as they have plainly this year in ſome inſtances, occaſion doubleneſs and proliferation.

C H A P. IX.

The PRACTICE.

IN July, when the purple Geum flowers upon its native Hills in Weſtmoreland or Yorkſhire, mark certain plants for ſeed. Select ſuch as have firm ſtalks, a healthy aſpect, and large flowers. When the ſeeds are ripe, cut off the heads; ſhake off the ſeeds, and ſpread them on a ſhelf in a dry room: turn them often, and let them lie twelve days: Then tye them up in paper bags, and keep them dry.

MIX ſome rich paſture mould with pond mud, rotted cow dung and river ſand: A barrow of each of theſe to a load of mould. Add three barrows of rich crumbly marle, and ſkreen the whole together. Let this be done in July, and the heap turned up once a fortnight.

IN Auguſt make the ſeed-bed with this mould. Defend it from the North winds, and let it be open only to the morning Sun. As ſoon as the bed is levelled ſcatter on the ſeeds: ſift over them half an inch of mould; and once in three days water the ground: laying a mat over the bed, and watering thro' that, not to diſlodge the ſeeds

THE

THE plants will appear in ſix weeks, and they muſt be thin'd to two or three inches diſtance. As the weather grows ſevere, earth up their tender heads, and in the extream froſts ſhelter the ground. Thin them again in ſpring, and keep the bed clear from weeds, and often watered, thro' the ſummer. The next Auguſt make a new and deeper bed of the ſame kind of ſoil with the firſt; and plant in it the ſeedlings. Allow them ten inches diſtance every way.

THEY would naturally flower the ſucceeding ſummer, but that muſt be prevented: It may be done by taking them up ſeveral times; and planting to a different quarter of the heavens. This I have found will keep the root a year longer before flowering, and it will be ſo much ſtronger for the full bloom. Then this and the marle give the great hope of doubleneſs. In the beginning of October take up all the roots; turn them about a fourth part of the horizon, and immediately plant them again. Do the ſame early in the ſpring; and twice more during ſummer; then let them reſt for flowering the next ſeaſon.

MANY of the flowers, when they blow in this manner, will be double; ſome more ſome leſs in degree, but all beautiful.

THUS are produced double Geums, and from the moſt double of theſe we may reaſonably expect proliferation. We are to prepare for it thus:

IN the autumn of the year preceding their flowering, mix up this Compoſt. Take five loads of rich black earth from a moiſt meadow: mix with it one load and a half of mould from the bottom of an old ſtack of faggots; one load of rotted cow dung, half a load of pond mud, and two barrows of clean ſand. Stir theſe together, and turn them now and then in the heap.

WHEN the Geums are in flower mark thoſe which have the moſt vigorous aſpect, and the doubleſt bloom. In Auguſt make a bed of this mould four feet thick; and plant in it thoſe Geum roots at a foot and half diſtance. Put them in five inches deep; and keep the bed well cleared from weeds. Water it often; and largely in dry ſeaſons.

THE plants will be very fine the next year, and probably that ſeaſon or the ſucceeding, will give proliferous flowers from abſolute culture. Theſe will exceed greatly what wild nature offers; becauſe they will be double as well as proliferous.

THE ſame courſe of culture may be eaſily adapted to all the other kinds, which we already know to be ſometimes proliferous; and may be extended to many new ones; ſelecting always polyandrous plants.

THE END.

DIRECTIONS to the BINDER.

Plate 1. to face page 6.—Pl. 2. p. 10.—Pl. 3. p. 14.—Pl. 4. p. 18. —Pl. 5. p. 22.—Pl. 6. p. 26.—Pl. 7. p. 30.

THE SLEEP OF PLANTS, AND CAUSE of MOTION IN THE SENSITIVE PLANT, EXPLAINED.

By *J. HILL*, M. D.

In a LETTER to LINNÆUS.

The SECOND EDITION.

LONDON:
Printed for R. BALDWIN, in *Pater-noster-row.*
M.DCC.LXII.

Advertiſement.

THE public will pleaſe to excuſe any particularity of ſtyle in the ſucceeding pamphlet; ſince its appearance is accidental in this form. I promiſe myſelf ſo much indulgence from their candour, when they ſhall know it was originally intended to be no more than the title expreſſes; a private Letter to a foreign Naturaliſt.

There is a freedom of ſtyle, and aſſured manner peculiar to this kind of correſpondence, which would be too aſſuming in works addreſſed immediately to the public; and might not unnaturally draw upon the author a cenſure of ſelf-ſufficiency and vanity. This explanation, I hope, will defend me from ſo unfair a charge: for indeed no one knows more the narrow limits of human knowledge; or entertains an humbler opinion of the returns for years of application.

That the experiments which were the occaſion of writing it, have added their mite to the ſtores of ſcience, will be allowed; for it has not before been known, that thoſe changes which are brought on by night, in what are called the ſleeping plants, and in the ſenſitive by a touch, could be at our pleaſure occaſioned at any hour; and without the touch, or any other motion.

As this depends solely on removing the cause which kept them awake (so it is the fashion to speak), and expanded, it will be allowed also that cause, though hitherto undiscovered, is known.

This is the utmost of the discovery; and from this I persuade myself nothing can be taken.

The word Sleep, used on this occasion, will, I am afraid, appear to the judicious British eye, an affected, as well as improper term: but the application of it lies at another's charge; and perhaps the manner of the country where he is native, will excuse it. Having thus disclaimed the word, I shall be pardoned for using it in the following discourse, when the reader considers it as a private letter, written to the person who first adopted the expression.

The preserving that term, and publishing the whole with the particularities which gave occasion to this apology, has been owing to a strict regard to truth; which prompted me to lay the letter before the public unaltered, rather than amended: nor has the publication of it in England, where the taste of science is not general, any other motive, than to save the tediousness of transcribing, for the use of a few, who have been pleased to flatter me by their desire of preserving the discovery in its original form.

To the Celebrated

LINNÆUS.

IT is not ſtrange to you to be addreſſed from remote countries; nor in the cauſe of ſcience can it be unwelcome.

Probably you have leſs expected this from me than any other; but I will not ſuppoſe you have leſs deſired it: The ſame purſuits have a long time engaged our attention; and it could not be that I ſhould paſs over your great name in ſilence. If our opinions have differed, 'tis upon a ſingle point; your arrangement of plants. In regard to that much greater article, the eſtabliſhing their diſtinctions, and aſcertaining their characters, I have always admired and reverenced you: to diſpute your determinations there, were to deny the characters of nature.

Free in the tribute of applauſe on this head, I have on the other been as open in my cenſures; equally uninfluenced by envy, and by fear. It is thus ſcience may be advanced; and you will permit me to ſay, thus men of candour ſhould treat one another. In this light I perſuade myſelf you have always ſeen my

my conduct toward you: that you have read with the ſame equal temper the cenſures of the *Britiſh* Herbal, wherein it came before me to examine ſyſtems; and the juſt applauſe of *Eden*, where the characters of genera, and diſtinctions of ſpecies were moſt to be conſidered; and that you will receive theſe impartial thoughts with more ſatisfaction, than all the little flattery of your pupils, or ignorant applauſe of thoſe who have not underſtood your writings.

Syſtems are vague and unſubſtantial; but thoſe diſtinctions are invariable and everlaſting: and many diſtributions may be formed upon the diſcoveries you have made of them. In this eſſential part of botany you have alone done more than all who wrote before you: and I am convinced you will entertain no enmity againſt me, who with equal freedom point out theſe excellencies, and what have appeared to me your imperfections; that you will read thoſe cenſures with no more reſentment than I wrote with malice; and will ſee on what foundation to build your fame: for I have often ſaid, and the world will ſay it, your ſyſtem is repugnant to nature, although your characters are her own.

This is the opinion I entertain of you; and in this confidence addreſs to you the preſent treatiſe: an attempt to explain the cauſe of a quality in vegetables, whoſe effects none has obſerved with ſo much diligence or accuracy as yourſelf.

S E C-

SECTION I.

That the leaves of certain plants assume at night a disposition different from that of the day, has been long known; *Acosta* records it of the Tamarind; *Alpinus* of that tree, and of the *Abrus* *; and from these, all who followed: *Alpinus* extends the observation to several other of the *Egyptian* kinds; and you have carried it much farther among the *European*.

That Author conceived it a provision of nature for the defence of the nobler parts, the flowers and fruit: and he particularly observes of the Tamarind, that its leaves embrace the tender pods.

This opinion *Ray* disclaimed, though he allowed the fact: but you have adopted it. I think it will appear upon a strict examination, that the change itself is a natural effect, resulting from the common properties of bodies, and their operations upon one another; and that the author of nature has in many instances made it effectual to that great purpose; though in others it happens equally, without answering such end.

We see how far the observations of earlier writers carried the discovery; how much farther your own: and I persuade myself you will accompany me with satisfaction in a more deep research.

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* Glycine foliis pinnatis conjugatis, pinnis ovatis oblongis, obtusis.

You

You have deſerved greatly of the world in this and other inſtances, by tracing nature's ſteps, and recording thoſe obſervations. To relate theſe facts is to give the hiſtory of nature: but there is ſomething more within our reach: The human mind, daring, though weak, and inquiſitive under all its limitations, ſeeks, and ſometimes not unhappily, their cauſes.

There have not been wanting from the time when this property in vegetables was firſt regarded, ſome who have ſought its origin; but all yet unſucceſsfully. Thoſe who ſuppoſed it the effect of heat and cold, might for a long time ſeem to have judged rightly; but when we find the ſame thing happen with equal regularity in ſtoves, where there is no change in the temperature of the air, we are convinced that opinion cannot be juſt.

They were as far from truth, who ſuppoſed the health or ſickneſs of the plant of any conſequence in this reſpect; nor can I affirm that I have found nature in all inſtances confirm your obſervation, that it is more obvious in young plants than old.

It will appear from the following trials, that the ſleeping and the ſenſitive plants are naturally allied; that their motions, though differently brought on, are dependent on the ſame principle; that many of the ſleepers approach to the quality of the ſenſitives; and that all the ſenſitives have theirs.

This will ſhew the ſubjects are connected, and the principal experiments will prove, that, with

with this connection, the principle of their motion is alſo found.

If I can cloſe the Abrus leaves at noon-day, and open them again at pleaſure, you will own, I know the principle of their change of poſition.

If I can throw down, as well as cloſe the leaves of the ſenſitive plant, without a touch, by removing the power which keeps them erect, and expanded, you will acknowledge the latent principle of their motion is alſo underſtood.

We always know the cauſe of thoſe effects we can ourſelves produce; and experiments are the true teſt of reaſoning.

SECT. II.

We ſee a great number of plants cloſe their leaves at evening. The fact is as obvious as it is ſtrange: but we know every effect has its cauſe; and we are to ſeek this, not by vague conjecture, but in the eſtabliſhed properties of bodies, and their known influence, in different caſes, upon one another.

The ſtructure of plants we may eaſily know; and of no part more perfectly than of the leaves: for a good microſcope ſhews their ſmalleſt veins.

Between the two ſkins of the leaf, which are continuations of the outer rind of the ſtalk, there run innumerable fibres of a larger kind; with cluſters of more minute ones, in various forms among them.

The large veſſels are of a woody ſubſtance; hollow; and ſmaller all the way from the baſe of the leaf: they are collected together in a compact manner in the footſtalk; with delicate cluſters at its baſe: and they are originally ſent from the ſtem.

They ſerve to ſupport the leaf in its proper poſition; and therefore whatever external or internal cauſe affects them, will change that poſition.

This is the conſtruction of the part to be influenced; the queſtion remains, what it is that affects it; and to know that we are to examine whatever may have ſuch power.

Leaves thus conſtructed are always ſurrounded by the air; and they are occaſionally and variouſly influenced by heat, light, and moiſture: The air alſo itſelf being in a continual ſtate of variation, its alterations are to be conſidered as poſſible ſubordinate cauſes of change.

Theſe things, and theſe only, come within contact of plants, or within the ſphere of influence. Bodies do not affect bodies, but on contact, or within that ſphere: therefore the cauſe of the change of poſition in leaves, is to be ſought among theſe agents, and no other.

They are naturally complicated, and they act on moſt occaſions together. We are therefore to obſerve, firſt, what effects reſult from their mutual combinations in a ſtate of nature: and having aſſigned in theſe caſes the effect to the proper and particular cauſe, from this power of that agent, whichſoever it is, that

acts

acts thus in concert with the reſt, we may deduce its operations ſingly.

SECT. III.

Pinnated leaves, ſuch as are compoſed of numerous lobes, or ſmaller leaves placed on a common foot-ſtalk, are moſt remarkable for their change of poſition: it will be therefore beſt to wave all other conſideration here; and obſerve ſolely the condition of theſe.

The four agents we have named are univerſal; but we ſhall find their operation differs in various climates. In theſe temperate kingdoms, our native plants which have pinnated leaves, naturally hold the lobes nearly horizontal, and ſhew but a moderate ſenſibility in this reſpect; in the hotter regions of the Eaſt, the uſual poſition of the lobes in theſe plants is turning upwards, and they are extremely ſuſceptible of change of poſture; in *Ægypt* moſt of all: in the more northern nations, on the contrary, they ſcarce ever reach an horizontal poſition, and they ſhew very little change on any occaſion.

As we ſee different appearances in theſe parts of plants in hot, temperate, and cold climates; obſervations of a like kind ſhew, they are not leſs variouſly affected in the ſame kingdoms in rainy and fair ſeaſons. In thoſe places where there are regular periods of rainy weather, the change in the face of the pinnated plants is very great, and certain: Thoſe which in the fair months carry their lobes in

an obtuſe angle upwards, conſtantly hang them obtuſely downward in the time of the rains.

Theſe are the obſervations of curious voyagers; and they have been confirmed by the immediate notice of botaniſts in thoſe places. The firſt would ſeem at once to give the effect to heat; and the other to moiſture: but farther obſervation ſhews it is otherwiſe. You have juſtly obſerved, that the ſame thing happens to plants in the ſtove, where there is no alteration in point of heat; and I have found by careful trial, that moiſture has in the ſame reſpect no effect: I have for this purpoſe watered ſome plants almoſt to deſtruction, and left others of the ſame kind dry; and no alteration has been made by this: They all expand, or raiſe their leaves in the morning, and drop them in the evening; at the ſame hour and in the ſame degree.

Two of the four natural agents, heat and moiſture, are therefore excluded from any ſhare in this effect: the air is too univerſal, and its changes too much depend on theſe, to be admitted in the reſearch. The attention therefore falls on light alone: and I have found by many experiments, that the change of poſition in the leaves of plants at different periods of the day and night, is owing to this agent and no other. This is the diſcovery I perſuade myſelf I have made; and I ſhall endeavour to ſhew, that it is founded on reaſon, and ſupported by experiments.

Nor is there any thing ſtrange in the effect, when duly examined. By excluding the ſuppoſed cauſes, we have diſcovered the real, for there

ere remained no other: and in examining the ſubject, on the principles here laid down, we ſhall find not only that no other power could produce the effect; but that light inevitably muſt.

Theſe are the diſcoveries on which the everlaſting ſeal of truth is ſtamped; which reaſon dictates; and which experiments confirm.

SECT. IV.

We have propoſed to ſearch the latent principle of this change in the qualities of bodies, and their natural operations upon one another.

We have ſhewn what is the ſtructure of leaves in general; and it will now be proper to fix on ſome one in particular: Let us chuſe for this purpoſe an *Egyptian* plant, ſince thoſe ſhew the effect moſt of all; and among theſe none can be more proper than the Abrus, celebrated for it by the earlier writers.

The leaf of this plant conſiſts of thirteen pair of lobes, fixed by very ſhort and extremely ſlender footſtalks to the middle rib; and this to the main ſtem of the plant.

Examining its internal ſtructure by the microſcope, we find a number of delicate fibres, riſing from the central part of the main ſtem, and continued in a courſe obliquely upwards, through the intermediate parts, and to the out-ſide of the rind. Here they ſwell; and run into ſeveral regular cluſters, ſpreading downward and on each ſide; and theſe form (under the continued covering of the ſtem) the

baſe

baſe of the common footſtalk, or middle rib of the leaf.

From this part they are carried in a ſmall compacted bundle, ſtrait forward to the extremity of the rib; and there, as there is no odd lobe to cloſe the leaf, they terminate in a point, covered by the common integuments.

From each ſide of this middle rib riſe the footſtalks of the ſeparate lobes. They are formed of a multitude of delicate veſſels, ranged cloſe together, and confined by the covering, which is the common rind of the plant continued to that part.

At the baſe of each lobe there is another complex cluſter of fibres. From this part they are protended forward, ſtrait to the end of the lobe; and they ſend out only ſlight branches into the ſeveral parts of the leaf.

This is the particular fabrick of the Abrus leaf, as ſeen upon a careful diſſection, and with a good microſcope: it agrees with the general conſtruction, we have given before, as the common courſe of nature in theſe parts; and it will regularly explain the change of poſture in the lobes, under the different influence of light.

Light is ſubtile, active, and penetrating; by the ſmallneſs of its conſtituent parts, it is capable of entering bodies; and by the violence of its motion, of producing great effects and changes in them. Theſe are not permanent, becauſe thoſe rays which occaſion them, are, in that very action, extinguiſhed, and loſt.

Bodies may act on light without contact; for the rays will be reflected when they come

extremely

extremely near: but light can act on bodies only by contact; and in that contact the rays are lost.

The change produced in the position of the leaves of plants by light, is the result of its motion occasioned by its rays among their fibres: to excite this motion, the light must touch those fibres; and where light touches, it adheres, and becomes immediately extinguished.

SECT. V.

These are the everlasting and invariable properties of light: and, according to these, the change we attribute to it, being once effected, must be continued as naturally and as necessarily as it began, so long as the light continues, and no longer.

The raising of the lobes in these leaves will be owing to the power of those rays which at any one instant fall upon them: these become extinguished; but others immediately succeed to them, so long as the air in which the plant stands, is enlightened. It ought therefore to be seen, that in full light, the lobes continue in their most raised position; and that they droop from that in proportion as the light becomes less.

This which appears necessary from the powers of light, and the construction of leaves, is true also in fact.

We have seen that the footstalks of these lobes, are clusters of fibres protended from the center of the stem; that they are continued

through

through the lobes; and that they support them in their position, whatsoever it is.

The effect of light upon these fibres is the putting them into an incessant vibration: This happens necessarily from the continual impulsion and extinction of the corpuscles, of which light is composed, and the fresh impulsion of others, upon the extinction of the first.

It cannot be, but that a cluster of delicate fibres, affected incessantly by these concussions, must be put into a vibrating motion; and this will be greater, as the light is more, and weaker as it is less.

This vibration is simple in the expanded fibres; but it operates as variously as distinguishably on those clusters of them which are placed at the bases of the main rib, and of the several footstalks of the lobes.

It is on the operation of light upon these interwoven clusters of fibres, that the motion of the leaves in gaining their different position depends; and consequently, the motion itself is various, according to the construction of those clusters.

In the Abrus they are large, and of a lax composition; consequently the lobes are capable of a drooping, an horizontal, and an oblique upward position: in the Tamarind, and the broad-leaved Robinia, they are more compact, and hence all the motion of which those leaves are capable, is an expanding open, and a closing sideways; which the direction and course of the fibres also favours; in the *Parkinsonia* they are smaller, and yet more compact;

pact; and the consequence of this is, that its lobes have no farther possible motion, than the expanding and closing upwards.

Hence the effects of a full light are different on various of the pinnated leaves; raising the lobes of some, as the Abrus, and opening or expending those of others, as the *Parkinsonia*.

The impulse of light, and the vibration it produces, are the same in all these instances: but the direction of that motion into which the lobes are thrown, is according to the course of the fibres; and the quantity of it, in equal degrees of light, to the construction of those reticulated clusters.

This universally appears on examination of the clusters of fibres by a microscope, and observation of the motion of the lobes: that motion being universally of greater extent, where the clusters of fibres are longer, and more loosely interwoven; and of less, where they are shorter, and more compact.

The effect of light upon bodies we see is to put their parts into a vibrating motion; the construction of pinnated leaves is such as naturally admits and propagates that influence; and the clusters of fibres are as a kind of joints on which their lobes are capable, under the influence of light, of a certain limited motion.

As the state of water uninfluenced by heat is ice, the natural position of the lobes in these pinnated leaves is drooping. This is their posture of repose: but in this they were not intended by the author of nature to re-

main; for vegetation is very imperfectly performed, while they are in it.

The effect of light is this vibration, and the alteration of position in those lobes. This is the doctrine here advanced, and this is supported by the following experiments.

SECT. VI.

I removed a plant of the Abrus from a stove, in the evening of the seventh of August, and placed it in my study, where it could have the effect of moderate day-light, without being exposed to the immediate action of the sun.

This might be conceived the most natural and equable degree of light; and therefore fittest for the first experiments.

The lobes of the leaves were at evening, when the plant was brought in, fallen perpendicularly from the middle rib, and closed together by their under sides.

Thus they continued during the night; in a state of perfect repose. Half an Hour after day-break they began to separate; and in a quarter of an hour after sun-rise stood horizontally; flat, and perfectly expanded. Long before sun-set they began to droop again; and toward evening they were closed underneath, as at first.

Next day the plant was set in a room where there was less light. The lobes were raised in the morning; but not to a horizontal situation; and they drooped earlier at evening.

The

The third day it was ſet in a ſouth window, open to the full ſun. Early in the morning the leaves had attained their horizontal ſituation; by nine o'clock they were raiſed conſiderably; and they continued in this ſtate till toward evening, when they by degrees fell to the horizontal ſituation; and from that drooped gradually to the uſual ſtate of reſt.

The fourth day the plant ſtood in the ſame place, but the ſun did not appear. The lobes obtained early their horizontal ſituation, but did not riſe beyond it; and in the evening cloſed as uſual, below.

S E C T. VII.

Theſe experiments ſhew the effects of various degrees of light: at the ſame time, that they prove the whole change to be occaſioned by light only.

The effect of moderate light, that is, the light of a bright day out of the ſun-ſhine, is to raiſe the lobes to an horizontal poſition: Leſs than this places them at an obtuſe angle downwards: more, at an obtuſe angle upwards.

The fifth day the plant was ſet in a leſs enlightened room: and the leaves had obtained by nine o'clock their poſition at an obtuſe angle downward: it was then brought into the lighter room, and they roſe to the horizontal ſituation in a quarter of an hour. It was then removed to the window, where the ſun ſhone, and the lobes were elevated as

 before;

before; and being thence carried into the less light room, they drooped again. All these changes were produced between the hours of nine and two, the weather the same, and only the place of the plant changed.

On the sixth day it remained in moderate light; and kept its leaves horizontal.

On the seventh I made the final experiment.

It appeared to me, that if light were the sole cause of the motion, and change of position in the leaves, then denying the plant the benefit of light at any time, must bring on that change: that it would not be difficult to darken the place where the plant stood, at any time: and that the consequence of this must be, if the principles already laid down were true, a bringing on of the change at any time of the day. This experiment appeared as a just proof of the foregoing reasonings: if darkness would at any time throw down the lobes, the system of that motion before delivered must be true; if not, that all the reasonings must be false.

The assent of the world must also depend on this. Deductions of reason may be disputed, but it will be allowed certainly, that we understand the cause of a change we can produce.

In the evening of the sixth day I set the plant in a book-case, on which the morning sun shines; and throwing open the doors, left the whole to nature. The succeeding day was bright. The lobes which had met in their

their drooping poſition at evening, and continued ſo during the night, began to open early in the morning, and by nine o'clock they had paſſed their horizontal ſituation, and were elevated in the uſual manner.

I then ſhut the doors of the book-caſe: the plant was by this left in darkneſs; and on opening them an hour afterwards, the full change had happened: the lobes were all dropped, and it was in the ſame ſtate that it would have ſhewn at midnight.

On the opening of the doors the change began very ſoon: and in twenty minutes the lobes had obtained their elevated ſituation. This experiment I have ſince many times repeated, and always with the ſame ſucceſs.

It is in our power therefore to bring on this ſtate of repoſe at pleaſure; and by the admiſſion or excluſion of light, to make the plant at our own time put on all its changes, from the drooping to the moſt elevated poſition of the lobes.

We know that in theſe experiments, light alone is the cauſe: we are therefore certain, that what is called the ſleep of plants, is the effect of the abſence of light alone, and that their various intermediate ſtates are owing to its different degrees.

SECT. VIII.

This being explained, a ſecond diſcovery follows naturally. The motion of the ſenſitive plant, at the cauſe of which no philoſopher

pher has hitherto ventured a conjecture, is in a great meaſure owing to the ſame principles: and the explanation of it, which before the effect of light upon the leaves of plants was thus ſhewn, muſt have been inveloped in impenetrable obſcurity, may now be regularly purſued.

The ſenſitive plant, beſide its ſingular quality of cloſing and dropping its leaves upon the touch, is ſubject to the ſame changes with the Abrus, and thoſe other kinds, we have named from the effect of light.

Theſe natural, as well as the accidental motions on the touch, I have traced regularly in the common ſenſitive plant: but before we enter on the detail of thoſe obſervations, it will be proper to remark, how nearly ſome other plants approach to the quality of this, and the other ſpecies of ſenſitive; which they have been hitherto ſuppoſed to poſſeſs alone.

This ſurprizing quality is a power of motion in the lobes and their footſtalks. No change of poſition can be made without motion of the parts, therefore the Abrus, and all theſe other plants have alſo motion.

They agree with the ſenſitive in diſplaying this motion from the power of light; and all that remains particular in the ſenſitive is, that it is capable of the ſame motion from another cauſe. This is an accidental ſhock of its parts.

S E C T.

SECT. IX.

Even that is a quality common to ſome other kinds, though in an inferior degree: for a Tamarind tree has lately under my obſervation, cloſed its leaves on motion.

A flouriſhing plant of this, a yard high, being brought from Mr. Lee's nurſery at Hammerſmith, to me in St. James's Street, in the middle of the day, came in with its leaves cloſed, as it naturally has them at midnight, and as the ſenſitive plant on being touched.

An Abrus ſuffered no change under the like circumſtances.

Hence we infer, that the ſame conſtruction of parts, which gives the ſenſitive plant the power of motion, is in the Tamarind tree, though leſs delicate; ſo that a ruder ſhock is required to bring on the change.

It is in a lower degree alſo in the Abrus, for light has that power, though the effect cannot, ſo far as we have yet ſeen, be produced by a ſhock.

Plants which ſuffer this change from the effect of light, may, though they do not univerſally, ſhew it alſo from motion; and all plants which are capable of this change by motion, ſuffer it alſo from the abſence of light.

Light gives their leaves that poſition, from which they are to be thrown by a touch: and the abſence of light takes the ſame effect with that touch; though in a ſlower manner.

The

The sensitive plant at noon-day has its leaves raised and expanded. The footstalks make an acute angle with the main stem, and the two leaves which grow on each of the first or lower ones, stand remote from one another. The lobes which compose these, are about twelve pair to each, and these also stand in an horizontal direction.

Thus the young plant appears in the middle hours of day. At the approach of evening, the lobes begin to draw themselves together upwards, as in the *Parkinsonia*; and the middle rib of each approaches toward the other: at night the lobes are as entirely shut upwards, as those of the Abrus downward, the two ribs are placed close to each other; and the footstalk which supports them both, hangs down.

This is the state of repose of the sensitive plant: into this it falls every night naturally; and into this it may, in the same manner as the Abrus, be thrown at noon-day in a darkened place.

SECT. X.

As we have seen the cause of this change in the Abrus to be light, and have traced the manner of the operation; it is easy to follow it also in the sensitive plant, through the same course of enquiry.

At the base of the footstalk, where it joins the main stem, there is a cluster of complex fibres: These have risen from the inner part, and pierced the woody sides.

From

From this complex cluſter, the fibres proceed in a ſtrait line up the footſtalk, till at the head of that, where the two leaves riſe, there is another ſuch cluſter: thence the fibres run ſtrait the length of the main rib, and ſend out on each ſide other cluſters at the baſe of every lobe. From theſe more minute fibres run ſtrait through the leaf, and ſend out lateral ſhoots.

This the microſcope diſcovers plainly; and this ſhews that not only the natural motions of the ſenſitive plant are the ſame with thoſe of the Abrus and others, but that the conſtruction alſo is the ſame in its kind, though more complex.

In the night the ſenſitive plant is not capable of the common motion on the touch, for the leaves are already in the condition whereto they would be reduced by it. In the day they riſe and ſpread: and 'tis then the ſtrange effect appears on touching them.

Light expands the lobes, ſeparates the ribs, and raiſes the footſtalks. It does this, by putting all the parts of them in a vibrating motion. This we have ſeen in the Abrus, is principally effected by means of thoſe cluſters of fibres which are placed at the baſes of the footſtalks. In this plant, as there are no leſs than three ſets of thoſe cluſters, the effects of the ſame principle are naturally much greater than in the Abrus, where there is only one.

The vibration of the parts is that which keeps the leaves of the ſenſitive plant in their expanded and elevated ſtate: This is owing to a delicate motion continued through every

fibre of them. When we touch the leaf, we give it another motion more violent than the firſt: this overcomes the firſt: the vibration is ſtopped by the rude ſhock: and the leaves cloſe, and their footſtalks fall, becauſe that vibrating motion is deſtroyed which kept them elevated and expanded.

That the power of motion in the ſenſitive plant depends upon the effect of light on the expanded ſurface of the leaves, is certain; for till they are expanded, they have no ſuch power. The young leaves, even when grown to half an inch in length, have no motion on the touch, though rough and ſudden.

To propagate the motion when the leaves are in a ſtate to ſhew it, there requires a perfect and confirmed ſtate of thoſe cluſters of fibres lodged at their baſe. This is evident: for when the young leaf has firſt come into the ſtate of vibration, a touch will make its lobes cloſe; but the effect is not continued down the footſtalk, till it is more confirmed. No ſhock on the young leaf will affect the footſtalk before it is expanded: hence the cluſters of fibres at the baſes of the lobes firſt acquire their due condition for motion; and afterwards thoſe at the head of the main footſtalk.

As there requires a due firmneſs to give the cluſters of fibres the ſuſceptibility of motion, and power of propagating it farther; there needs alſo a concurrence of favouring circumſtances, to preſerve them in that delicate ſtate wherein they are capable of exerting theſe powers.

The cold air hardens the fibres and impairs their ſuſceptibility of motion. The ſenſitive plant becomes more languid in this reſpect when removed out of the ſtove.

The correſpondence between this motion, and what you have called the ſleep of plants, or their natural cloſing of their leaves at night, appears alſo in this inſtance: for as the ſenſitive by being removed out of the ſtove, loſes in ſome degree the quality of cloſing its leaves on the touch, the Tamarind by the ſame change loſes in great part its quality of cloſing the leaves at evening. This is probably owing to the juices ſtagnating in the cluſters of fibres, and to the contraction of the bark by cold.

The communication of motion is leſs from the lobes to the footſtalk; and greater from the footſtalk to them. The greateſt ſhock is given to the plant by a rude touch of the ſtem: but even this does not affect the unexpanded or young leaves.

The analogy between the effect of a ſudden motion, and of the abſence of light is confirmed alſo by this; for as light decays naturally at evening, or artificially by ſhutting up the plant, the lobes firſt cloſe, and the footſtalks afterwards fall.

The power of abſolute darkneſs is greater on the ſenſitive plant, than that of the rudeſt touch. The rudeſt touch will only cauſe the lobes of the ſeparate leaves to cloſe, and the footſtalks to hang down: the two leaves will remain far aſunder. The effect of abſolute darkneſs exceeds this; for the two leaves

close alſo abſolutely together, and it appears as if the footſtalk ſupported only one. This proves that the expanſion of thoſe parts depends ſolely upon the effect of light; and that although it may be diſturbed by a ſuperadded and ruder motion, yet it can be taken away abſolutely only by darkneſs; by the defect of that to which alone it was owing.

Theſe experiments every one may eaſily repeat: the obſervations will be familiarly made by any who have ſtoves: They are conſtant and invariable; and the concluſions from them are certain; for no other cauſe intervenes.

The effect of light is continual while the light continues. The plant therefore whoſe leaves have been thrown down, and cloſed by this rude ſhock, is immediately affected by the light, as at its firſt appearance in the morning, or as on its admiſſion, when the leaves had been cloſed by artificial darkneſs. The vibration begins; and if the light be at its full ſtrength, the expanſion and elevation of the lobes is ſo quick, that one may almoſt look upon the plant, and ſee it. A few minutes often perfects it.

That the touch of the leaves no other way affects them than by a motion greater than their own internal vibration, is plain from this, that if they be touched with a finger in ſo deliberate and gentle a manner as not to move them, no effect is produced: and on the other hand, if they be any other way moved, the full effect follows.

If the pot be ſhook, though no part of the plant be touched, the leaves cloſe, and their footſtalks fall: or if the wind blow them, the effect is the ſame.

Hence it is certain that the expanſion of the lobes, and elevation of the footſtalks in theſe pinnated plants, is occaſioned ſolely by that vibrating motion, in which their parts are kept by the continual impulſes of light: and conſequently that in all of them they collapſe or ſink on the abſence of light; and in the more delicate kinds upon the ſhock of any ruder motion, which for the preſent ſtops that vibration.

Hence alſo the different appearance of pinnated leaves in various climates is underſtood; and may be aſſigned to its true cauſe, which is the different degree of light.

In the Eaſt the lobes are expanded, not becauſe of the heat, but becauſe the light is ſtrong: In the northern kingdoms they droop, not from cold, but becauſe the air is leſs enlightened: In the rainy ſeaſons they alſo droop, but it is not from the moiſture, but the darkneſs of the weather; and in *Ægypt* they are moſt raiſed of all, not becauſe it never rains; but becauſe the light is conſtant.

The Abrus placed in a ſouth window perfectly ſhews this; for the expanſion and elevation of its leaves is proportioned always to the degree of light, and conſequently it is affected by the cloudy or clear weather, though the plant remain in the ſame place.

The lobes begin to riſe before the ſun is above the horizon, becauſe the air is enlightened in a proportioned degree; and they begin to cloſe again long before it ſets, becauſe in the ſouth window the ſhadow of the building darkens the air about them.

In the rainy weather which we have now lately had, the leaves wore the ſame appearance they would have done in a plant native of a country where there are ſeaſons of rain; they never at any time of the day reached the horizontal poſition, and they drooped much earlier in the afternoon, and began to expand much later in the morning.

The ſenſitive plant which was placed near the Abrus, was affected in the ſame manner: and by repeated and careful examination, I have always found, that in both theſe and in all others, the degree of elevation or expanſion in the lobes, is exactly proportioned to the quantity of light; as it is ſolely dependent on it.

When the ſenſitive plant has been kept out of a ſtove ſome days, and has loſt ſome part of its power of motion, if the leaf be touched ſoftly, and the force encreaſed gradually, it will bear a great deal without drawing up the lobes; but at the ſame time a much leſs preſſure given with a ſudden ſtroke will occaſion their cloſing.

In this manner we may alſo trace the extent and progreſs of the motion according to the force; a ſlighter ſhock raiſing only the lobes that are touched, a harder the oppoſite ones, and ſo the whole.

This

This quality in the leaves of plants, as their general ſtructure is the ſame, and the ſame agent operates univerſally, ought to be found in all; though in various degrees, according to the conſtruction of their parts. In this, as all the preceding inſtances, juſt obſervation confirms the principles deduced from reaſon. In ſome it is greater, in others leſs; in many obvious to the common eye, in others difficultly perceived by the moſt accurate; but on a ſtrict and cloſe examination, I have not found any plant or tree wholly deſtitute of it.

SECT. XI.

That the curious who ſhall chuſe to repeat the experiments mentioned in the preceding pages, may find no difficulty in that reſpect, I ſhall give the particulars of the plants, and apparatus with which I made them.

The Abrus, Senſitive, and Tamarind, I obtained, in pots, from the nurſery of Mr. Lee, near Hammerſmith: a perſon whoſe induſtry and knowledge in his buſineſs, will ſome time make him known, to his advantage.

The microſcopes were thoſe of Mr. Cuff.

The Abrus was a flouriſhing plant, of two feet and a half high: the Tamarind ſomething taller. The Senſitive was a young one; in which ſtate there are only two pinnated leaves upon each footſtalk.

A plant of this growth is moſt manageable out of a ſtove, and was preferred for that reaſon;

ſon; but the ſame experiments made on thoſe of larger growth, anſwer in the ſame manner.

The place where they were kept, unleſs when removed for the particular experiments which required it, was a ſouth window.

The Abrus will live very well in ſuch a ſituation at this ſeaſon of the year; and the Senſitive, with due care, may be kept in tolerable perfection in the ſame manner, a fortnight or three weeks; though much more tender than the other.

The apparatus for the experiments, beſide the microſcope, conſiſts only of a fine penknife, and a flat board, covered with a piece of cork, ſix inches long, and three broad.

In order to trace the courſe of the fibres, and ſee their cluſters diſtinctly, a leaf of the Abrus muſt be pulled off, by ſlipping it downward. This brings away its baſe entire, and is neceſſary for obtaining in perfection the cluſter which is ſituated there.

The leaf muſt be laid flat upon the cork, and fixed down by a ſmall pin, thruſt through the middle rib, a little above the place where the firſt pair of lobes are inſerted.

There muſt be a good light, and a careful ſteady hand, and the point of the penknife muſt be kept ſharp and clean.

It will be eaſy to let this in at the middle of the rib, a little above the inſertion of the firſt lobes, and to ſplit the rib thence equally to the baſe.

The object is neither too minute for the hand, nor the eye; nor does it require thoſe

powerful

powerful magnifiers, which are often needful in the more delicate reſearches.

The cluſter of the fibres at the baſe of the main footſtalk, will be thus ſeen: they will appear cut more or leſs exactly in two, according to the diviſion of the ſtalk, and their courſe and interwoven texture afford a pleaſing object.

This is the firſt expermiment to be made; and it is very happy that the conſtruction is ſeen without great difficulty, for it leads the way to the reſt, which being minute, require a more ſtrict ſcrutiny.

The courſe of the fibres along the middle rib, and their cluſtering at the baſes of the lobes, may be purſued by ſplitting the footſtalk farther up: but as this is not eaſily done, I have been uſed to cut off the upper and under part of the leaf, and leaving only a piece, which has one pair of the lobes, and to cut it acroſs in the centre of their baſes.

This requires a careful eye, and a very regular preſſure of the penknife; but with ſo much caution, it may always be done ſucceſsfully.

At the baſe of each lobe there will be ſeen a cluſter, in all reſpects reſembling the firſt, only more delicate; and from that the fibres will be found continued in a ſtrait courſe along the middle rib, as they are in the ſame way along the footſtalk, from the firſt cluſter.

This way the eye perceives that there are ſuch fibres, that they are ſo cluſtered, and that their courſe is regular from thence. The fact is ſo aſcertained, but to admire duly the con-

ſtruction on which this motion depends, the fibres muſt be ſeparated from all ſurrounding matter, and laid before the double microſcope in water.

The method is this:

Let a leaf be pulled from the Abrus, as before, and in the ſame manner cut into two or three ſhort pieces; two lobes remaining with each: let the footſtalk be ſplit firſt at the baſe, and afterwards croſswiſe at each joint; thro' the baſes of the two lobes, and into the centre of the middle rib of each.

Let the ends of the lobes be cut off; and a number of theſe pieces be put into a ſaucer of water, keeping them down by ſome little weight.

They muſt lie in this water two or three days, according to the warmth of the weather; and at the end of that time they muſt be preſſed gently againſt the bottom of the ſaucer, with a piece of muſlin tied to the end of a pen, or other ſuch implement.

This muſt be done with a delicate hand, and repeated often. They will be thus cleared from all ſurrounding matter. The firmneſs of their own texture will preſerve them. They muſt be afterwards put into freſh water, and left four or five hours to ſwell and recover their firſt diſpoſition; and then laid in water before the double microſcope. The courſe of their fibres in their ſimple and cluſtered ſtate, will be thus perfectly ſeen, and the mechaniſm by which the motion in the lobes is performed eaſily underſtood.

The

The method with the Senſitive plant is to be exactly the ſame. The footſtalk ſupporting the two leaves, muſt be torn off downwards, and the leaves expanded on the cork with pins, as directed for the other. The baſe of the footſtalk muſt firſt be ſplit with the penknife; then the baſe of each leaf on the head of this ſtalk, and after that the baſe of each lobe. The conſtruction in this part is very obvious, for it ſwells up extremely, and appears as a kind of joint, to ſerve the motion.

The condition of the cluſters of fibres when the footſtalk is juſt ſplit, is more or leſs diſtinctly ſeen according to the age of the plant, the place of the leaf, and the degree of nouriſhment. It is moſt diſtinct in a leaf taken from the lower part of a young plant; but not the loweſt, or any placed ſo low as to be fading: and in the ſame manner the conſtruction at the baſe of the lobes is beſt ſeen in the ſecond pair from the baſe of the footſtalk.

Theſe directions will be uſeful to thoſe who will not be at the pains to clear the parts in water: but that way there is no difficulty in bringing the whole plainly and perfectly to view. I am,

With great reſpect,

S I R,

Your Humble Servant,

London,
Sept. 7,
1757.

JOHN HILL.

Index of the Sections, with their Contents.

FINIS.

ALERIAN.

O R,

The Virtues of that Root

I N

NERVOUS DISORDERS;

A N D

The CHARACTERS which diſtinguiſh the TRUE from the FALSE.

By JOHN HILL, M. D.

Illuſtrated with FIGURES.

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VALERIAN.

INTRODUCTION.

PHYSICIANS find uncertainty in the effects of Valerian; and the medicine has lost some part of its credit: I beg they will hear the following reasons. When the causes of that uncertainty are shewn, the remedy will be easy.

By the application to these purposes botany becomes useful to mankind: and 'tis a misfortune the science is so little cultivated in England. Some should enquire into the state of drugs; and determine with equal freedom against ignorance and fraud: but this cannot be expected from the physicians; for the superior care of health does not allow them leisure: the age is not deficient in HIPPOCRATES's; but there wants a *Cratevas*.

CHAP. I.

Of the Nature of the Root.

BY VALERIAN, we understand the root of the large wild plant of that name: its superior virtues having banished the other kinds. This grows on heaths, by rivers, and in woods: but

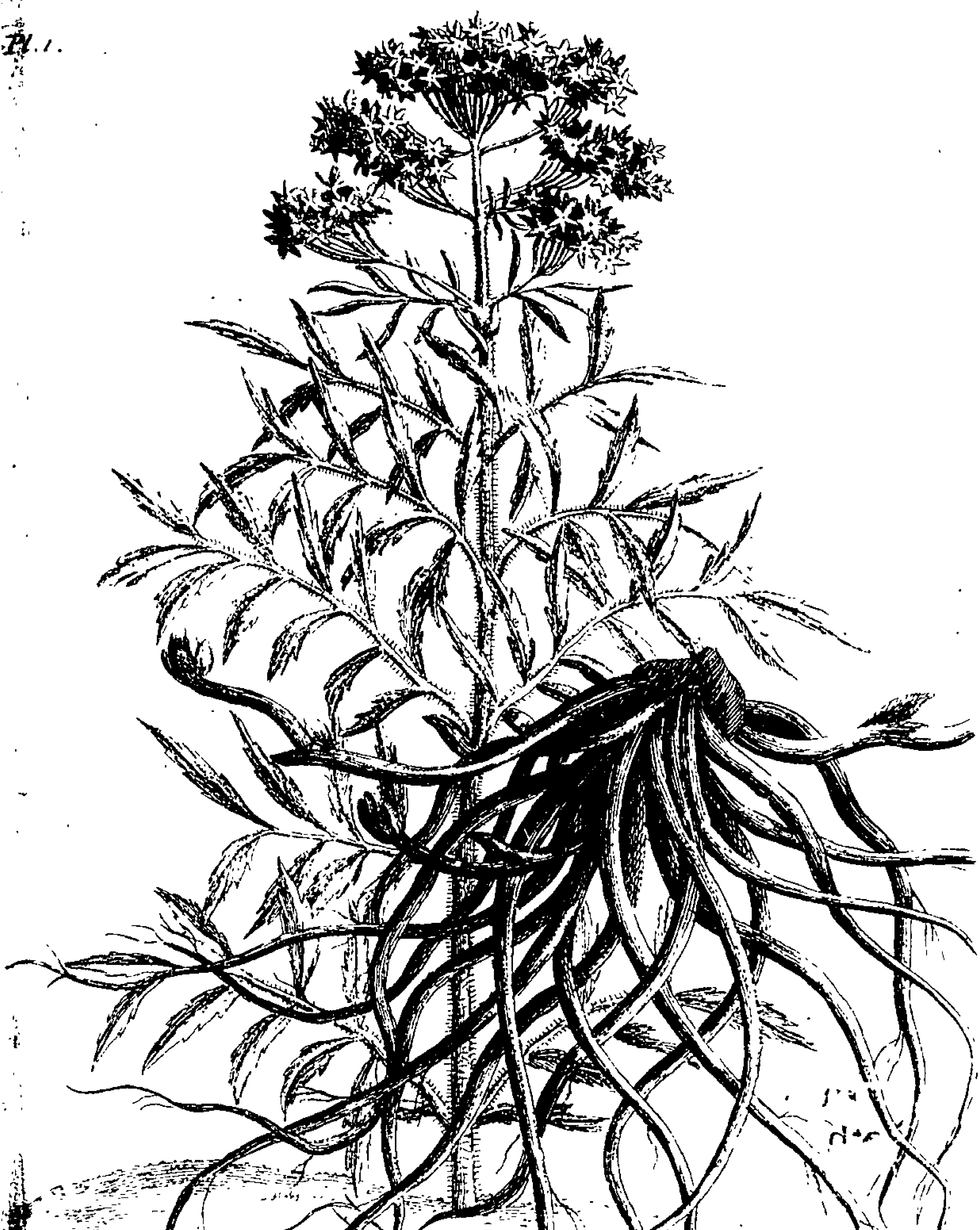
does, not in all theſe places, equally poſſeſs its virtues. When in perfection, it is highly aromatick: we know that quality depends in a great meaſure, on ſun and air; and is impaired always, and often is deſtroyed utterly, by ſhade and water; therefore the roots of Valerian which grow upon dry hills and ſun-burnt heaths, poſſeſs its virtues in the higheſt degree; and ſuch only ſhould be uſed in medicine. Unhappily the plant is more common by waters; and the roots are in wet places larger, and more eaſily taken up. A pound of theſe is brought into the ſhops for a dram of the other: and as they are greatly inferior in their qualities, the phyſician is diſappointed who depends on them.

Not only the virtues, but the ſtature, colour, and whole aſpect of the plant are altered by this watery nouriſhment: and though in reality the two kinds are only varieties, occaſioned by the different ſoil, yet they are ſo conſiderable, that Ray and others have given the mountain Valerian, a diſtinct place in their catalogues, accounting it a different ſpecies from that growing by waters.

I[illegible] woods it aſſumes a form diſtinct from t[illegible]; and properly is of a middle kind between them. Its virtues are alſo of a middle character: inferior to thoſe of the heath, and ſuperior to thoſe of water Valerian.

The excellence of Heath Valerian is ſuch that no other ſhould be uſed; and there is enough of it for the demand. The diſtinction is obvious, as will appear by the ſucceeding

Pl. 1.



TRUE WILD VALERIAN

ing characters: and as the term WILD belongs equally to the wood and water kinds, as well as to the true, it may be proper to diſtinguiſh that hereafter, by the name HEATH VALERIAN.

CHAP. II.

Deſcription of the Plant, and of the freſh Root.

THE root is compoſed of many fibres joined to a ſmall oblong head. The ſtalk is erect, round, jointed, hollow, and toward the bottom, reddiſh. The leaves ſtand in pairs; and each is compoſed of many leſſer leaves joined to a long rib, with an odd one at the end. The flowers are ſmall and reddiſh; and they ſtand in large tufts at the tops of the ſtalks and branches. Each flower is formed of one piece; and is tubular at the baſe, ſwelled out on one ſide, and cut into five parts at the rim. It has no cup: and each is followed by a ſingle ſeed.

This is the form of the plant in whatever ſoil it grows. The diſtinctions of the heath from the water Valerian are theſe.

The HEATH VALERIAN is about two feet and a half high. The ſtalk is of a duſky green, and lightly hairy: the leaves are ſmaller than in the water kind; and the little leaves of which each of the larger is compoſed, are narrower, and of a deeper colour: theſe are alſo covered with fine white hairs. The flowers are of a brighter red; and the cluſters of them are ſmaller. The ſeed alſo is leſs.

The

Water Valerian is four feet high. The ſtalk is of a pale green, and thick; the leaves are large, ſmooth, and broad, and they are alſo of a freſh pale green. The flowers are paler; but in larger cluſters than the other; and the ſeed is larger and ſofter.

This is the diſtinction of the plants at full growth: but as the beſt time of gathering the roots is before the ſtalk riſes, 'tis neceſſary they ſhould be known alſo in that ſtate. The place might indeed be a ſufficient direction: for no one would go to gather the root by a river, when he has been told the Water Valerian is of leſs value. But that ſuch as have not opportunities of taking it upon themſelves, may have ſome mark by which to know when it is genuine, it may be needful to add, that many ſuch leaves as we have deſcribed on the ſtalk, riſe alſo immediately from the root; and the ſame diſtinction is preſerved in them: theſe in the Heath Valerian, are compoſed of narrower parts, and are hairy and duſky in colour; in the Water Valerian, they are bright, ſmoother, and pale.

The great diſtinction is in the root itſelf. This in the true heath kind, is of a fine brown colour, tending to olive; and conſiſts of long ſlender fibres, which have a multitude of ſmaller threads growing from their ſides in the manner of ſhort curled hairs.

The root of the Wood Valerian is of a tawny, or deep browniſh yellow.

The

WATER VALERIAN

The root of the Water Valerian, is of a pale brown tending to yellow; and is composed of thicker and more naked fibres. There is lately introduced also a kind which has grown in absolute water: This is white, and is worst of all. The root of the Heath Valerian is firm and tough; the root of the water kind is tender and more easily broken: the Heath Valerian root has a fresh aromatick scent, with a very little fœtidness. The water kind has nothing of this freshness in the scent, and little of the aromatick; but is in a manner heavy and fœtid only.

By these characters the plants will be known in whatever period of growth; and even the roots when brought without any part of the herb. But since many have not opportunities of seeing these when fresh, it will be proper to observe also their condition dry, at the druggists.

These are supplied with it by persons who want knowledge, and often honesty: there is therefore no dependance, except upon the absolute aspect of the root. The distinction in this article is the more necessary; because the plant must be wild to have its virtue. Garden culture debases it almost as much as a watery nourishment abroad. This I have found by trial. Where a drug must be received from such hands, as usually deal in Valerian, it is necessary to be very well acquainted with its genuine characters.

CHAP. III.

The History of the Valerian of the Druggists.

THE Valerian sold at our druggists is collected by certain itinerant medicine-mongers, whom, from the principal article in which they deal, we call VIPER-CATCHERS: these people who travel over the kingdom in search of those animals, bring in also Valerian roots, and some other articles.

As they find a hundred plants of the Water Valerian for one of the Heath kind, that is, the root they usually collect: if the other falls in their way, and will come easily out of the ground, as it will in the looser heath soils after rains, they mix it with the rest: if not, they let it alone entirely. So that we sometimes meet with great quantities of the water kind only; and sometimes a mixture of one and the other. The first should be refused entirely; and the latter carefully picked. Besides this mixture, they put in also the roots of a small Meadow Valerian, a distinct species: and other kinds less pardonably. I have raised a plant of the smooth water crowfoot, which is poisonous, from a root sold among Wild Valerian.

Even this is not all the disadvantage. The time when roots have their full virtue is before they shoot up a stalk; but the plant is most obvious when in flower: the root also at that time

is

is looser in the ground, and the stalk is a handle by which it is easily drawn up. For these reasons a great part of what is brought into the shops has been taken out of the earth when the plant was in flower; and is therefore, even though the kind were right, unfit for use in medicine. Of all these imperfections the druggist should beware; for his care will make the gatherers honest: if he be negligent, the apothecary should refuse to take such as is bad into his shop: and in case of both these being careless, the patient may examine the root himself, according to the following characters.

CHAP. IV.

Description of the false Valerian Root when dry.

THE WATER VALERIAN ROOT dried is *brittle* and of a pale brown, approaching to *yellow*: it is composed of many rounded fibres, which are often entirely *naked* or at the best hung with a very few threads; and at the head there are commonly seen the *remains* of a *stalk*, with a hollow equal to that of a goose quill. Among the true fibres of the root, are also several long and *thick strings* of a paler colour, and *jointed* as it were; with a kind of dent at each joint. These are the creeping appendages of the root, by which it runs under the surface: they have nearly the nature of stalks, and are as destitute of virtue as straws. When the real fibres of this root are tasted, they are a little acrid, but *faint*, and a fœtid scent is per-

 ceived

ceived in them while chewing. If they are broken, they appear *hollow* in the midſt, or at the beſt dark and *blackiſh*. In the firſt caſe, the pith of the root is conſumed, which is the common ſtate of it after the plant has flower'd; the other is the natural condition of it in watery places; and is a certain ſign of its wanting ſtrength. The ſubſtance which ſurrounds the pith in the Valerian root, contains its greateſt virtue. This is ſpungy and woody in the Water Valerian, but in the heath kind, it is firm, and contains a ſubſtance approaching to the nature of a gum-reſin. This a watery nouriſhment cannot ſupply; and therefore that part in the Water Valerian is periſhable, whereas in the other it is permanent.

CHAP. V.

Deſcription of the true Heath Valerian Root when dry.

THE TRUE HEATH VALERIAN ROOT is compoſed of long and ſlender fibres: it is *tough*; and of a *duſky brown*, approaching to *olive* colour; and the fibres are hung about with *numerous threads*: when broken, they have no hollow in the centre, nor any blackiſh circle there, but appear full and bright; and if the root has been gathered in perfection, there is a circle of a greeniſh or pale hue ſurrounding the pith.

The taſte differs from the other much more than the colour, or form: it is acrid, ſpicy, and pleaſant;

pleaſant; and after it has been chewed ſome time, there is perceived a ſlight bitterneſs, and ſome aſtringency. It may be always known by this from the falſe; which is vapid and ſweetiſh, ſcarce at all aromatick, and deſtitute entirely of this latent bitterneſs and roughneſs.

Its virtues depend wholly on the principles which give this taſte and flavour; and they cannot be found in the other diſagreeable and offenſive kind.

This is the root, and this only, which ſhould be gathered for medicinal uſe, and it is indeed a very valuable medicine. A phyſician of diſtinguiſhed abilities, one of the late cenſors of the college *, has told me, that in a ſearch, *they* found this true Valerian Root at one, and only one ſhop in London; the powder was of an olive brown, and the ſcent aromatick and agreeable: at other places, the powder was of a yellowiſh brown, and the ſcent offenſive.

This true kind is liable like the falſe, to have runners mixed among the real fibres; and they ſhould be ſeparated: it may be eaſily ſeen whether the plant has been in ſtalk at the time of its being gathered, and if it have, the root ſhould be rejected. 'Tis only in perfection when preparing to ſhoot a ſtem: and whoever will gather it at that time, will find this kingdom affords drugs equal to thoſe of the warmeſt climates.

* Dr. CONYERS.

CHAP. VI.

Farther Trials of the two Roots.

VAlerian root is ſometimes altered a little in colour, from the foulneſs left about it at the time of gathering; or from ill management in drying. In this caſe, let ſome of it be put into cold water, and ſtand twenty-four hours. This never fails to diſtinguiſh the water from the heath kind; for the Water Valerian root becomes yellower, as it ſwells; and the other gets more of the olive brown than it had while dry.

The ſcent of the two roots alſo diſtinguiſhes them; if they have not lain together. The true is fragrant, though with a mixture of the fœtid kind; the other abſolutely ſtinks, and has ſcarce any thing of the aromatick ſcent.

Cats, who have much more diſtinguiſhing organs of ſmell than we, perceive this. There are certain ſcents which affect them, and they are principally of the fœtid kind; though this is not without exception: they will buſy themſelves extremely about the Water Valerian root; but ſhew little regard to the other.

CHAP. VII.

Of gathering the Root.

THESE are the characters by which the true Heath Valerian is to be known from the falſe; which is uſually ſold under its name.

When

When a parcel of the right kind is purchaſed, before it is uſed, it ſhould be picked and cleaned: thoſe roots which ſhew they have borne a ſtalk, ſhould be rejected; and the runners, or jointed and light ſtrings muſt be ſeparated from the true fibres. Thus the druggiſt may be ſure he ſells what the doctor preſcribes: but there ſtill may remain a doubt about its value. The high flavour of the Valerian root is loſt in keeping; and the virtue in great part goes with it.

This root ſhould never be uſed when it has been long kept; and the ſeller's word is not to be taken on this account, for he is always intereſted to call the old new.

Under theſe diſadvantages, to which the purchaſe of Valerian is ſubjected on all hands, nothing can be ſo rational as the patient's collecting it for himſelf. Where that cannot be done, let him be guided by the ſame rules in the purchaſe, that he would obſerve in collecting it: let him buy it freſh; at a right ſeaſon of the year; and in the perfect ſtate and condition: this he will know by the following rules.

Roots poſſeſs their virtues in greateſt perfection when they are ready for ſhooting up a ſtalk, but have not yet made the effort: 'till that time they are imperfect, becauſe they have not obtained their full maturity; and after that they are exhauſted. The ultimate end of nature in the growth of plants, is the formation of the ſeeds: when theſe are perfected the root is no longer uſeful, it becomes a ſtick:

and

and while the ſtalk is in its growth, the rich juices are ſent up ſo faſt to it, that the root is in great part drained of them. Therefore, neither when the plant is in flower, nor when it is about to flower, ſhould its root be gathered for medicinal purpoſes. While it has only the radical leaves it may: but the beſt time of all is juſt when the bud of the ſtalk is forming.

The growth of the Valerian is this. In July it flowers; in Auguſt the ſeeds are ripe; and the winds carrying them off, they ſtrike root. The rains of autumn favour this; and a ſmall cluſter of leaves is formed: theſe, with the root, continue growing till the ſevereſt froſts; or in mild winters through the whole ſeaſon.

About the time when the ſeeds fall, thoſe runners before-mentioned, riſing from the head of the old roots, ſpread themſelves juſt under the ſurface, or ſometimes upon it; and, taking root, they alſo form new plants. Each ſhoots up a cluſter of leaves, and ſends fibres into the earth, juſt as the ſeedlings.

Among the roots we find at druggiſts, ſome are large and light; others ſmall and more firm: the large ones are uſually ſuch as have been pulled up by the ſtalk, at, or after the time of flowering, which are therefore in a great degree exhauſted: the ſmall ones are the roots of ſeedling plants, and of thoſe propagated by the runners, which have been taken up late in autumn, or early in ſpring: and theſe having been in their earlieſt ſtate of growth, have not

their full virtue. This is the condition of the ſingle roots brought to ſale; and in the cluſters of them, there is the greateſt uncertainty: the larger part being exhauſted, and often rotten; and the reſt imperfect.

The true ſeaſon for gathering Valerian is the middle of May, and the fineſt roots are thoſe of ſeedling plants. Theſe are known by ſtanding ſingle; thoſe from runners being always near old roots. Theſe ſeedlings have had the autumn and winter for taking their firſt growth. The warmth and moiſture of ſpring have now given them their full bigneſs, and the rudiment is new formed, which is to ſhoot up into a ſtalk. The root is full of its richeſt juice: and that is the proper ſeaſon for gathering it.

In the ſyſtem of vegetation, this is an univerſal truth: the root which has produced a ſtalk, and ripened flowers and ſeeds becomes an abſolute chip; and has neither medicinal qualities, nor any other value. The purpoſe of nature is anſwered, and the whole plant uſually dies. The MUSA will live a century if it does not flower; but when it has once bloom'd no art can preſerve it from immediate decay. The MOUNTAIN PALM, will live thirty or forty years barren; but if it flowers it inſtantly periſhes; and the TREE LAVATERA, which bears our winters even for many years, till it blows, dies as ſoon as that is over. Even annuals, by preventing their flowering, may be kept alive thro' winter.

In bulbous plants the root decays viſibly; and

and in the fibrous it has the ſame fate, though leſs obſerved. The carrot which has run to ſeed, is an inſipid ſtick: and in the potatoe, though freſh roots are produced abundantly, that which was put into the ground in ſpring, and which has borne the ſummer ſtalk is uſeleſs.

The gardener thinks he takes up in July the ſame bulb of the tulip, which he planted the laſt November; but he deceives himſelf. That which he ſets in autumn furniſhes the flower in the ſucceeding ſummer; and, as it feeds the ſtalk, decays. Another bulb is formed during this time, which contains the rudiment of the next year's flower: this encreaſes as the other withers; and having attained its full growth by the middle of ſummer, the gardener takes it up, and ſuppoſes it to be the ſame he planted.

What we call a bulbous root is nothing more that a covering of the rudiment of the plant; like the bud upon a tree: and the coats of the bulb, like the films which compoſe that bud, when they have performed their office decay, and are renewed no more. The rudiment of the Valerian plant is a bud in the centre of the head of the root; of the ſame kind with the other two: and the root itſelf has the like fate. It naturally periſhes in the winter, when the plant has perfected its ſeeds; and others are formed round about it, which ſupply its place.

All this is tranſacted in the boſom of the earth, and at a time when roots are never taken up by the judicious: therefore it is little ſeen: but it is the abſolute courſe of nature. The off-ſets of bulbs, and the encreaſed parts of

fibrous

fibrous roots, which the gardener ſeparates in parting them at autumn, are all formed in this manner; containing the rudiments of other plants, and ſupplying the place of the old ones which decayed in flowering.

It is neceſſary ſo much ſhould be known, to direct us in the proper gathering of roots; and thus the philoſophy of plants may ſerve the purpoſes of medicine.

CHAP. VIII.

The manner of curing Valerian Root.

VALERIAN is in its greateſt perfection when freſh dried: but the curing of medicinal roots, is a ſubject we do not rightly manage in England. The *Ginſeng* of the Eaſt-Indies, and the *Salep* of the Turks, are inſtances that others have an art unknown to us.

We cannot preſerve any root as they do Ginſeng; and with regard to Salep, our own Orchis would perfectly anſwer its purpoſe, if we had the ſame method of curing it. This is not ſo difficult as may be thought; but it would be wandering from the preſent purpoſe, to ſpeak farther of the matter here.

When the Valerian roots are gathered, let the dirt be ſhook from them, but not by ſtriking them againſt hard ſubſtances. It will ſeparate with little violence; and they muſt neither be bruiſed nor waſhed. Let the leaves and runners be cut off clean without wounding the head of the root, and then lay the whole

parcel in a heap in a dry place, where the ſun does not come: cover them with a blanket, and leave them thus three days: then ſtring them up on long threads at ten inches diſtance root from root, and hang theſe threads acroſs an airy room.

When they are perfectly dry, put them up in boxes, preſſing them cloſe together, and cover them carefully.

If any think laying the freſh root in heaps, before it is hung up to dry, a ſtrange practice, they may be reminded of the cuſtom in regard to fruits, whether intended for keeping, or for wine. Thoſe who underſtand their management, always give them a ſweating of this kind, for heightening their flavour, and improving their natural qualities.

The gardener lays his pears in a heap, and covers them with flannel, before he ſpreads them to keep for winter: and in the cyder countries, apples are treated in the ſame manner before preſſing; and in the vineyards, grapes.

A ſlight fermentation is thus brought on by the warmth of the ſubſtances; and their flavour and virtues are exalted and improved. I don't know that the ſame practice has been applied to roots before, but the effect is ſimilar; and thoſe who have not been accuſtomed to Valerian otherwiſe than as ſeen in the ſhops, would ſcarce ſuppoſe this the ſame medicine: it is highly aromatick, quick, and pungent on the tongue, and the peculiar flavour in it, which we call fœtid, ſcarce deſerves ſo coarſe a name.

The root of Heath Valerian in this ſtate poſ-ſeſſes all the virtues which have been aſcribed to it by authors. It is a ſovereign medicine in nervous diſorders; and in particular exceeds all the remedies commonly uſed againſt that worſt of head-achs, which ariſes from attention.

It has alone cured epilepſies: and of late has been uſed very ſucceſsfully in hyſteric complaints; and in that terrible diſorder the convulſive aſthma: It allevates pain in the manner of the more gentle opiates; and is found highly effectual in fits proceeding from the obſtructions of the menſes; not only taking off the ſymptoms but removing the cauſe. Perhaps this root may be found, on experience, one of the beſt of our emmenagogues; and I would requeſt thoſe who have more opportunities, to try it farther in that intention.

A very large doſe of the freſh root will purge; but this is its leaſt uſeful quality. I have ordered it lately in that troubleſome diſeaſe the nightmare; and in two inſtances, wherein I have had fair opportunities to try its virtue, have found it a perfect cure.

A very good method of taking it is freſh dried in the way of tea, a dram of the root for a doſe, with half a pint of boiling water; ſweetened, and ſoftened with a little milk: but of all the preparations, a tincture fully ſaturated with the ingredient is the beſt. The root poſſeſſes its full virtue only when it is freſh dried, after it has been taken up at the ſeaſon juſt named. At that time of the year it is excellent in powder, or in

the tea-infusion; but no method of keeping will preserve it long in the same perfect state. therefore the best recourse is to this form: and proof spirit is capable of receiving so strong a tincture from it, that a small dose will have great virtue. I have this year obtained from different parts of England a large quantity of the true root, and have found that an excellent tincture may be made from it in the following proportions.

Cut a pound and four ounces of the root just dried into small pieces, and bruise it in a mortar; put this into a gallon of proof-spirit; let it stand four days, shaking it every day; then strain off the liquor, pressing it hard. Put to this a pound of the root, bruised as before, and let it stand a week: after that strain and filter ter the tincture. A table spoonfull is a dose. It should be taken in a small glass of water, or of mountain wine once or twice a day.

I have made a quantity in this manner, which is at the service of my friends, or of the faculty; the rest of the root I have given to Mr. Tomson, a very worthy young man, who proposes to make it for the publick.

One farther improvement it is proper I name here, though sufficient experience has not yet confirmed me in its full use: this is an ACID TINCTURE OF VALERIAN. I have made this by adding two ounces of oil of vitriol to a pint of the preceding tincture, and have found it excellent: the acid exalts the flavour of the Valerian, and this tincture strengthens the stomach, creates an appetite and always prevents that disor-

der

der of the head, to which nervous perſons are ſubject after eating. The doſe of the Valerian being in this form limited by the acid, the plain tincture may be alſo taken at other times,

The roots ſold by druggiſts differ extremely in colour, taſte, ſmell, and qualities; as they have been gathered in more or leſs favourable ſituations and ſoils: the difference between the falſe and true, is that the one has grown in barren and dry ground; and the other in wet and muddy; and in conſequence there are as many degrees of excellence or defect in the drug, as there are of ſoils between thoſe two.

There are ſeveral parts of England, where the true kind is to be had in plenty. On the great heath called Hind-Head, in the road to Portſmouth, I have ſeen a vaſt quantity of it; and Ray names it upon ſufficient authority near Aſhwood, by the Buxton-wells, in Derbyſhire; at Parnham, between Brindale and Orford, in Suffolk, and on Ilford Common.

The chief places whence the roots are brought to London for ſale are four; the neighbourhood of Cambridge, the foreſt of Dean in Glouceſterſhire, Oxford, and the near part of Kent. The Cambridge and Kentiſh Valerian generally have a mixture of good and bad; for they pull up ſome from the heaths and high grounds, which they mix among the water kind: what I have ſeen from about Oxford, has more of the Water Valerian; and from the foreſt of Dean comes the pureſt and beſt our druggiſts have: but this, like the reſt, though the kind be better, is commonly taken up at a wrong ſeaſon.

'Tis

'Tis said none is imported: but I have found among parcels of Valerian some roots of a kind differing in colour from almost any of the English sorts; and also the tuberous white roots of the *nardus montana radice olivari*, which is a Valerian, not native of this kingdom; therefore those parcels of the drug probably came from France, and could not but be worse for the keeping. It does not appear that any part of the world produces this drug in greater perfection than our own country, provided the soil and situation be proper.

That soil, and situation, can make so considerable a difference in the virtues of plants, appears from various instances in nature; and as plainly from the effects of culture. Lavender and other aromatick herbs, are sweeter, and fuller of virtue in those kingdoms where they grow wild, than with us who raise them only in gardens; and many which we have wild in common with the south of France, are yet greatly superior in their qualities there.

Culture renders the common garden plants larger and more succulent; but it takes off their taste and qualities: and the difference between the Heath and Water Valerian is very like that of a wild and garden herb; the situation in the muddy bank of a ditch, giving abundant moisture, and nourishment.

We see the same plant is more richly flavoured when it grows in a dry soil, and more insipid when in wet; and we find the highest aromaticks are natives of dry and

warm

warm land: indeed to know the effect of abundant moiſture and rich earth, we need look no farther than the common lettuce. In the wild ſtate, wherein it lives on dry, parched, and barren ground, its juice is acrid and bitter, and its virtue highly narcotick; ſo much as to have obtained it the name of poiſonous: in gardens where it has rich mould, and abundant moiſture, it becomes mild, pleaſant, and innocent. Nor does the form differ leſs: when wild the ſtalk is woody, and the leaves are prickly: when cultivated the ſtem is tender, and the leaves are unarmed. So the auſtere crab of the common, becomes the mellow apple of the orchard; and the bitter almond ſweet.

The caſe is the ſame in all theſe inſtances; the virtues or the qualites of the herb, root, or fruit, depend upon the natural and moderate quantity of juices elaborated, undiſturbed in its veſſels; and well concocted by the ſun. This gives the taſte, ſcent, flavour, and medicinal qualities. When nature throws its ſeeds in a rich wet ſoil, or human induſtry removes them to the garden, the character of the plant is altered, the effective particles are debaſed or drowned in the additional quantity of juice, and the whole becomes in the end taſteleſs, ſcentleſs, inefficacious, and inſipid.

On theſe principles the culture of the Valerian in gardens muſt never be attempted; and in its wild ſtate ſo much depends upon the nature of the ſoil and ſeaſon of the year, that it is happy the characters of excellence and imperfection

imperfection are marked so strongly on the root itself.

Those who neglect to observe them will be disappointed in their expectations from this drug, though in reality it possesses all the virtue that has been ascribed to it; and deserves more commendation than has been given it even by its warmest advocates.

THE END.

Directions for placing the PLATES.

PLATE I. to face page 4.
PLATE II. to face page 6.

AN

ACCOUNT

OF THE

MUSHROOM-STONE.

Illuſtrated with FIGURES.

[Price One Shilling and Sixpence.]

AN

ACCOUNT

OF A

STONE,

IN THE

Possession of the RIGHT HONOURABLE the EARL of STAFFORD;

Which on being WATERED

PRODUCES EXCELLENT MUSHROOMS.

With the HISTORY of the

IOLITHOS, OR VIOLET-STONE OF THE GERMANS.

By JOHN HILL, M. D.

Illustrated with FIGURES.

LONDON:
Printed for R. BALDWIN in Paternoster-row.
M DCC LVIII.

TO THE

RIGHT HONOURABLE

THE

EARL OF STAFFORD.

MY LORD,

IF there be any addition to the knowledge of nature in the obſervations which the following ſheets contain, 'tis fit that I acknowledge the world owes them to your Lordſhip, who gave me opportunities of making the experiments.

DUTY

Duty, as well as inclination, enjoin me therefore to lay the treatiſe at your Lordſhip's feet: nor can I ſuppoſe, you will conſider, as unworthy of your notice, the leaſt enquiries into the boſom of nature; ſince they are to the glory of that Almighty power whom your Lordſhip's heart adores with more than common reverence; and whoſe greatneſs, will be always the more diſtinctly ſeen the better his works are underſtood.

It were eaſy to exhauſt the whole ſtore of dedicatory eloquence in an addreſs to your Lordſhip: for, to name the Staffords, and the Howards, your great Anceſtors,

ſtors, were to ſum up all that is moſt ancient and moſt noble; but neither does your Lordſhip's ear deſire this tribute; nor have I the heart, or the deſigns, of thoſe who offer it. If I ſhould praiſe your Lordſhip, it would be on another ſcore; your virtue, and your piety: and I muſt be permitted to ſay, that if I may judge the thoughts of others by my own, your Lordſhip is of all men the moſt to be envied; paſſing the autumn of Life in honourable eaſe, removed from all connections with a bad world, but that of doing good to the wretched; and enjoying that ſuperior happineſs, which riſes from true goodneſs.

MAY it continue long!

I HAVE the honour to be with the greateſt deference and reſpect,

My LORD,

Your LORDSHIP's moſt

obedient, and moſt

humble Servant,

PALL-MALL,
Auguſt 18, 1758.

J. HILL.

AN

AN

ACCOUNT

OF THE

MUSHROOM-STONE.

INTRODUCTION.

THE Italian naturalifts mention a ftone which on being wetted produces mufhrooms; and from their writings an account of it has paffed into thofe of other nations, under the names of LAPIS FUNGIFER, and the MUSHROOM-STONE. Some who have been in Italy have alfo feen it; and we have been furprifed with their accounts of its effects: but as thefe have not been regarded with fufficient accuracy, nor the fubftance itfelf perfectly underftood, it may not be difagreeable to the curious to receive a plain account of

the

the ſtone and its productions from one of them now in England, which fully anſwers what has been related of thoſe in Italy.

THE COUNTESS OF STAFFORD, in whoſe poſſeſſion it is at this time, has given me opportunities of examining the courſe of its productions; and valuing a diſcovery of the truth, more than even the curioſity itſelf, has permitted me to make experiments upon it with all poſſible freedom.

WITH theſe advantages I have endeavoured to find the true nature of the ſubſtance; and hitherto without injuring the ſpecimen itſelf: the vegetable principle is ſo ſtrong in the ſtone that it has perfectly recovered the rough treatment which has been enneceſſarily given it in the courſe of this enquiry; and probably will continue to yield its valuable growth many years.

CHAP.

CHAP. I.

Of the Nature of the Stone.

THE Italians deſcribe the Lapis fungifer as a coarſe and looſe kind of ſtone: they ſay, that it retains always the quality of affording muſhrooms when watered: and that the ſubſtance now in poſſeſſion of lady STAFFORD is the ſame they mean, is evident from its appearance, conſtruction, and qualities. It is a hard heavy maſs, of an irregular ſhape, and granulated ſurface, like ſhagreen leather; in colour brown with a tinge of reddiſh, and very difficultly broken. This is its appearance in the maſs when dry. The piece of it now in England is fourteen inches in diameter: when broken it appears rough and gritty, full of ſmall glittering particles, ſome black, others white, like grains of different coloured ſand; and among them are ſome flakey ſubſtances of the nature of the foliated talks. Theſe are connected together by a browniſh matter, with ſtreaks of white; and the whole maſs has, when freſh

broken, ſomewhat of the appearance of thoſe coarſe granites, which we call, from the place where they are found, Guernſey pebbles, and with which the ſtreets of London are paved. If a knife be haſtily drawn over this it yields ſparks of fire; and tho' it has not nearly the hardneſs of the ſtones whoſe conſtruction it reſembles, yet the ſmalleſt particle of it is not eaſily broken.

On putting a piece of it into hot water innumerable air-bubbles riſe from all parts of it, like ſmall round bladders. After ſome time the ſubſtance ſwells a little, but looſes nothing of its form; and if there have been upon the piece thus uſed, any part of the original ſurface of the maſs, 'tis eaſy to perceive by the naked eye, that it is covered with a kind of ſkin, or coat. The maſs, when kept under ground, and often watered, becomes ſofter, but it never moulders away; nor do the pieces thus ſoaked in hot water ever crumble or fall aſunder, like earthy ſubſtances.

The ſtrongeſt acids, even aqua fortis, makes not the leaſt impreſſion upon it. It

lies

lies in them unaltered as in water, only ſending up a few air-bubbles.

A STRONG fire conſumes a part of the maſs; and leaves the reſt in form of a looſe various coloured ſand.

THESE are the experiments by which ſtones are uſually tried; and by theſe the preſent ſubſtance appears to be a congeries of cryſtalline and talky particles. But as part of the maſs burns away, that is plainly not of a ſtony nature; and its ſmell while burning ſhews that it is not bituminous: we are therefore to look for it in the vegetable kingdom; and from this part alone we ſhall find the muſhrooms produced from the ſtone ariſe.

ON examining a piece of it freſh broken with an attentive eye, the ſurface reſembles in miniature that of a piece of the PUDDENSTONE when roughly broken. There ſtand out in many parts ſmall tubercles or grains of the gritty matter, ſome white, ſome black, ſome cryſtalline, and others talky; and between and among theſe are little hollows, out which other pieces have fallen.

WHAT

WHAT the unaſſiſted eye thus diſcovers, a microſcope perfectly explains to us. On looking over the various parts of ſuch a piece of ſtone, we find the original ſurface covered with a thin coat. Pebbles have their cruſt; and many kinds of ſtone their coats, of a different colour from the reſt of the ſubſtance; but theſe are flinty. On the other hand, the kind of ſtony maſſes which this reſembles have naturally no coat or cruſt; and this covering which for that reaſon only we might reaſonably judge to be adventitious, is not of a ſtony but a fungous nature. It coats the ſurface with a thin expanded tough ſubſtance, and inſinuates itſelf from the outſide inward in thinner plates into all the natural crevices of the ſtone. As this is compoſed of a mere looſe grit, there are interſtices and cavities in every part: the ſeveral particles of the ſtone are ſo looſely thrown together that there is room for this ſubſtance to inſinuate itſelf any where between them; and even to ſurround them. This it does in courſe of time, and of conſequence the inner part of the ſtone appears a kind of fungous bed, incloſing a multitude of gritty particles; or as if by any art a

piece

piece of ſpunge could have all its cavities filled perfectly with ſtone.

THIS holds the naturally looſe particles of the ſtone firmly together; and lines the beds or hollows out of which others have fallen.

THIS conſtruction appears ſtill more plainly when we examine a piece of the maſs which has lain ſome time in water; for the fungous matter ſwelling with the moiſture ſhews itſelf thus, yet more diſtinctly. The coat or outer covering of the ſtone appears whitiſh on its inſide; immediately under this we ſee another expanſion of greater thickneſs, which has a perfect fungous aſpect; and from this we may trace the ſame ſubſtance running in irregular plates in every crevice, and ſurrounding every particle of the ſtone.

THIS tough and fungous ſubſtance is the perennial root of a peculiar ſpecies of muſhroom, different from the common kind, and greatly ſuperior to it. To this ſubſtance is owing the continual production of the muſhrooms; and as all plants have their proper place of growth, this ſtone is that of the pe-

culiar muſhroom, which we ſee riſe from the root thus ſpread thro' it. See PLATE I.

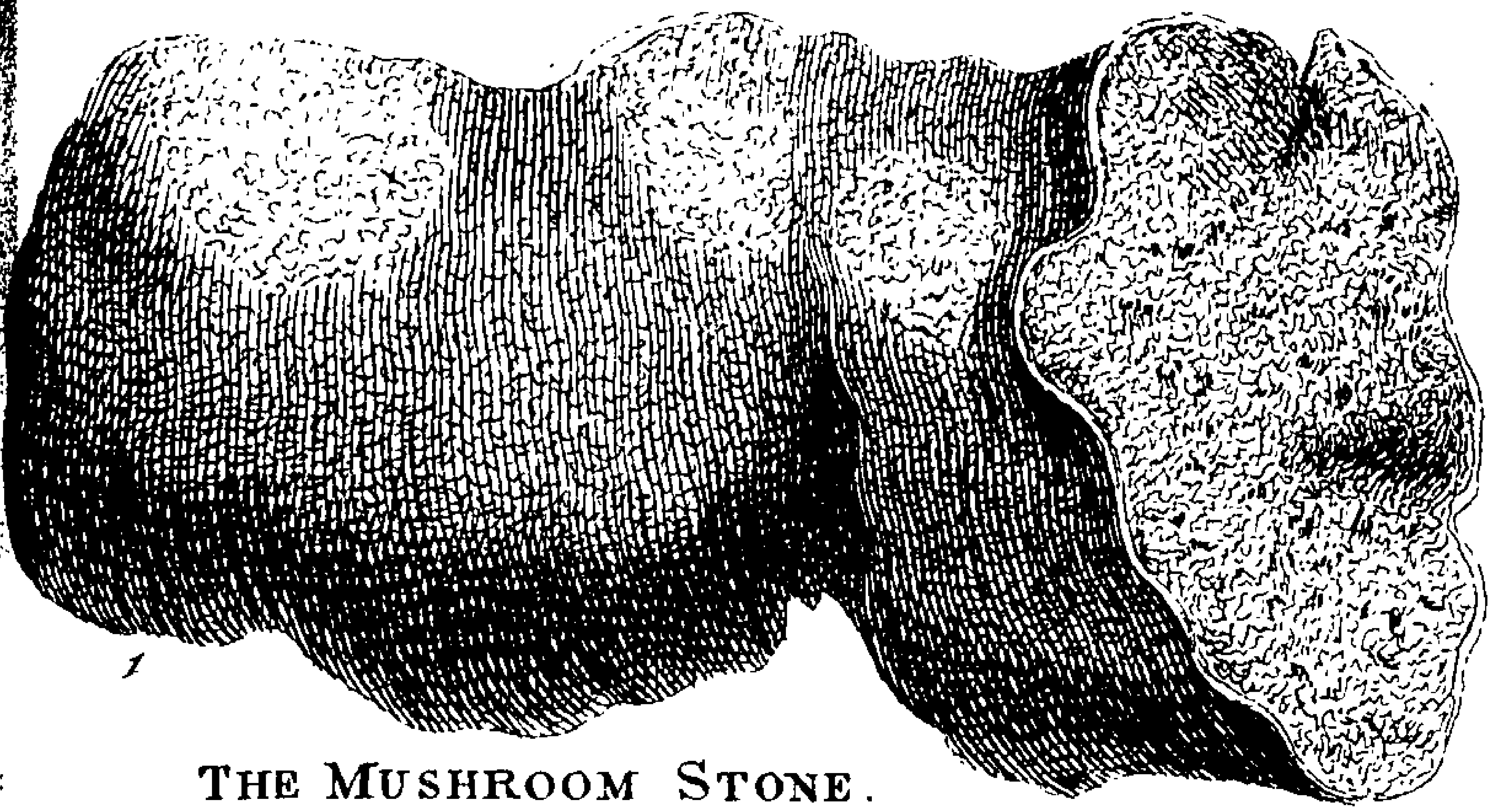
CHAP. II.

OF THE NATURE OF THE MUSHROOM PRODUCED FROM THIS STONE.

WE know by the preceding experiments diſtinctly and certainly that the Lapis Fungifer is a ſtone, compoſed of cryſtalline and talky particles, and penetrated every way by the roots of a peculiar muſhroom, which are permanent and full of vegetable life, which require this nidus or place of growth, as others do the ſtumps of trees; and which are ready to ſhoot up perfect muſhrooms by the aſſiſtance of moiſture.

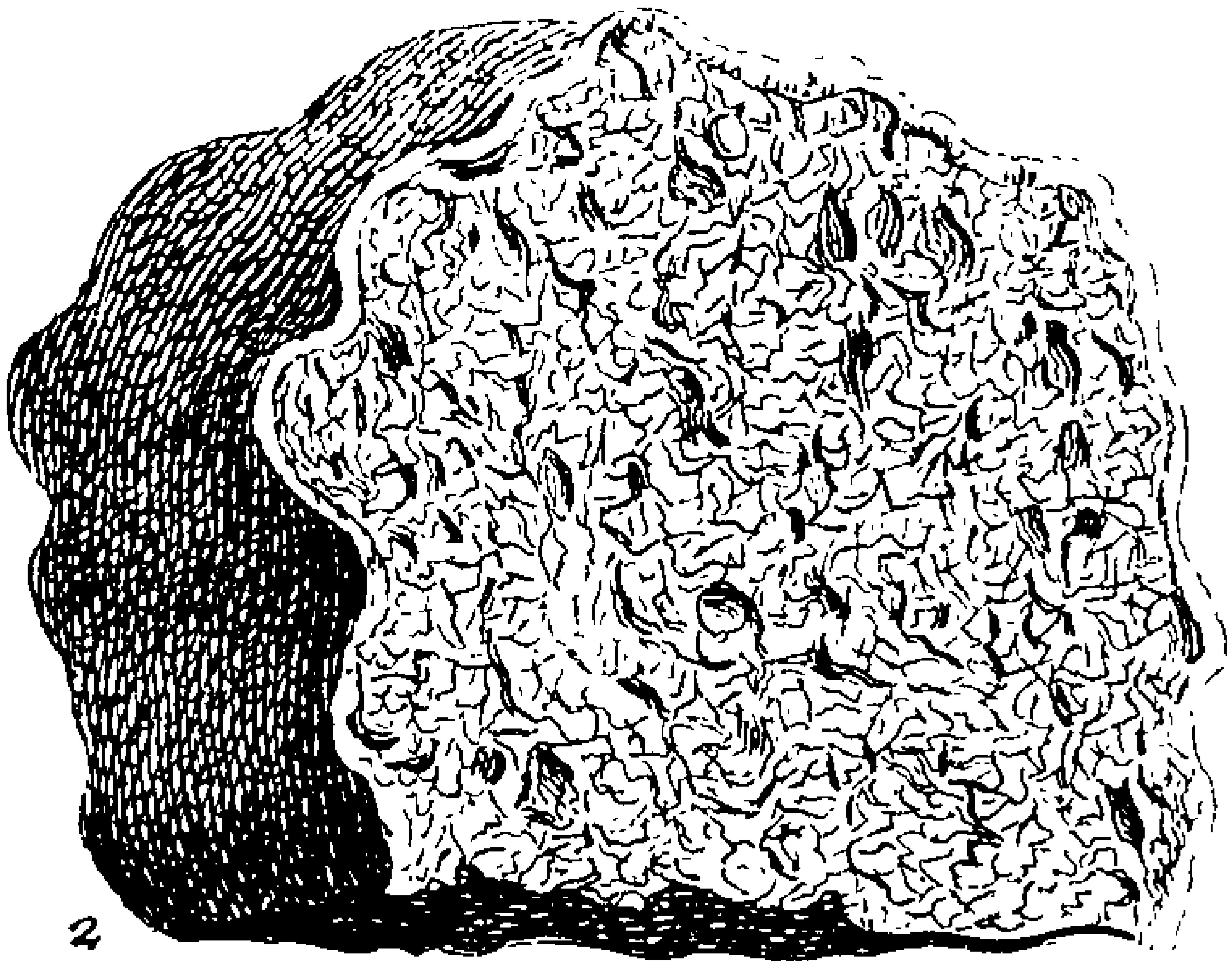
THE name of a muſhroom with a perennial root may appear ſtrange to ſome; but it is not peculiar to this ſpecies: ſeveral of the Agarics which grow on trees riſe from laſting roots, which penetrate the rotten parts of the wood, and in the ſame manner remain many

years.



1

THE MUSHROOM STONE.



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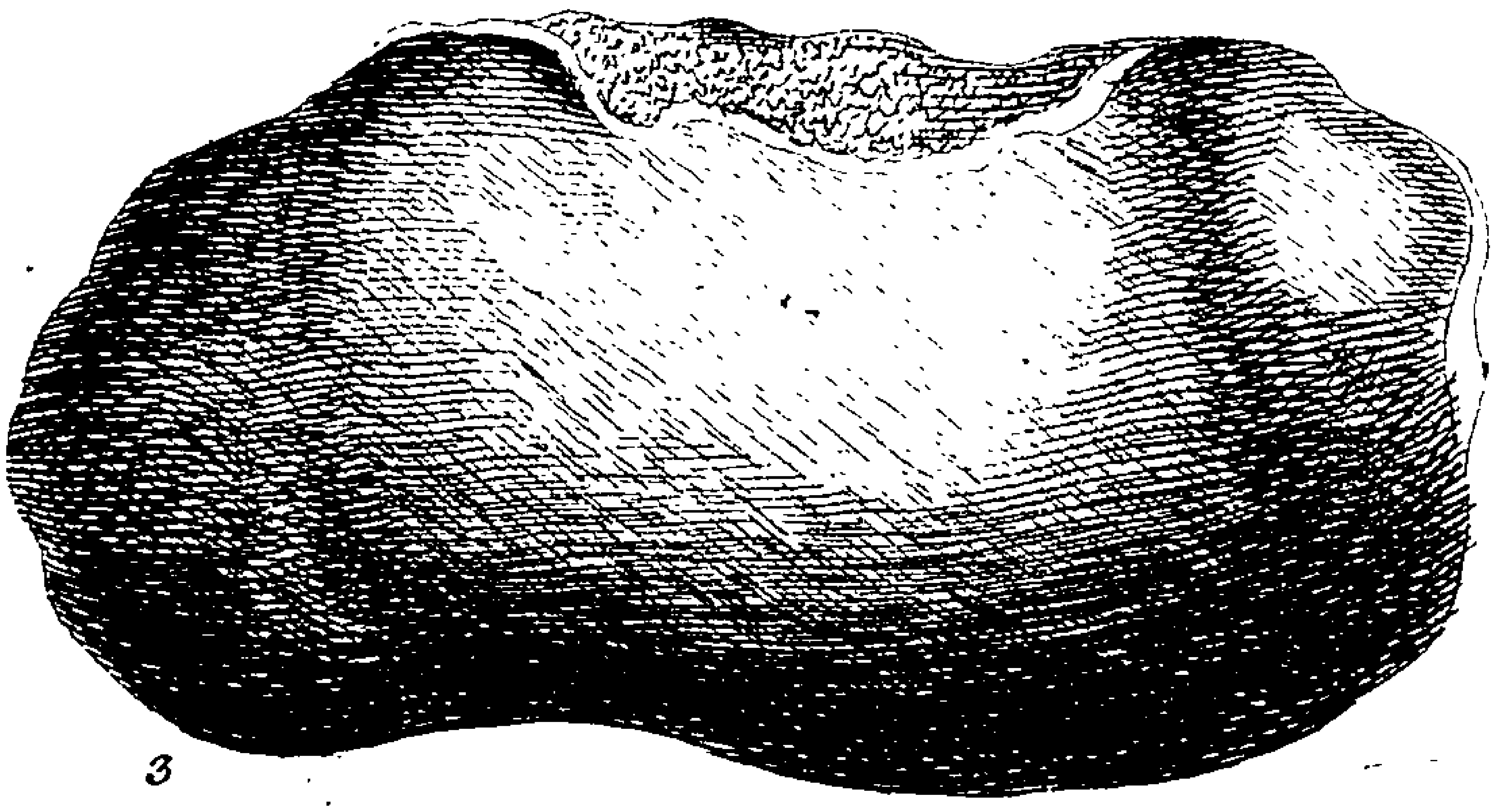
A PIECE of it MAGNIFYD.



3

THE VIOLET STONE.

years. Theſe reſt unſeen in the body of the tree during the ſummer; but the rains of autumn which eaſily get at the part where they lie, ſet the muſhrooms to growing. An inſtance of this ſhewed itſelf very conſpicuouſly many years in the wood near THORNDON in Eſſex: where every October there appeared upon the trunk of an old aſh, in a part where a large limb had been long before torn off by the wind, a cluſter of that kind of fungus which Dillenius calls the Liver-agaric, *Agaricus poroſus rubens carnoſus hepatis facie.* This I ſeveral years ſucceſſively obſerved, in company with that great ornament of Botany, the late excellent lord PETRE: we found that theſe muſhrooms conſtantly aroſe from the ſame ſpot; that when they were decayed there remained always a fungous ſubſtance in the place, like the coat of this ſtone, from whence we could trace numerous broad and flat fibres inſinuating themſelves into all thoſe interſtices of the wood which the decay had made; and alſo between the wood and the bark. Theſe roots were in all reſpects analogous to that fungous ſubſtance which runs over the ſurface, and into

the cavities of this ſtone; and like them wanted only moiſture to ſend up perfect muſhrooms of their kind. Dr. Vütner has obſerved the ſame annual production of agarics from certain ſpots of trees in the Harts foreſt in Germany; and Buxbaum in Ruſſia: In London we had for many years an annual fungus of vaſt ſize, and of a very peculiar form, from the block of a ſmith's anvil in the Hay-market; and Tournefort has given a like inſtance of one on a beam in one of the churches in France, which has, I believe, ever ſince appeared at the ſame ſeaſon.

If the ſpots whereon theſe ſeveral muſhrooms grew had been examined with ſufficient attention, I perſwade myſelf, the ſame kind of perennial roots would have been found as I have ſeen in the aſh at Thorndon, and in the muſhroom-ſtone: thoſe two are perfectly ſimilar in their nature; and differ only in form; as their productions do in management.

The root of the aſh agaric was flat and ſtringy; that of the rock-muſhroom is irregular

gular and ſpongy. The aſh produces its agarics in autumn when water naturally falls upon the place, or when the damp temperature of the air ſupplies its office. The rock yields its muſhrooms at any time, becauſe it is watered at pleaſure.

The ſtones which afford theſe muſhrooms are found in the mountainous parts of Italy toward Piedmont; and alſo in Sicily and ſome other places. They lie in irregular maſſes from one to twenty, thirty, or forty pounds in weight upon the ſurface, or juſt covered: many of them only in part buried in the ground; and ſome of them, though not all, are covered with this fungous coat.

Those which lie wholly on the ſurface are often irregularly overſpread with it; but they rarely produce any perfect muſhrooms. Theſe riſe principally from ſuch as are an inch or two within the mould, and they appear to grow out of the earth till they are traced to the root. Thoſe ſtones which are in part buryed and part expoſed to the air, often crumble away unleſs they are covered with

this

this fungous ſubſtance; and in that caſe the muſhrooms uſually riſe from the part juſt within the ſurface.

If thoſe which lie altogether expoſed, and are covered with the imperfect fungous matter, be by any accident, or purpoſely, covered with mould, there will riſe from them perfect muſhrooms; and any of the ſtones thus covered being put into mould, will produce them.

CHAP. III.

Of the Growth of Mushrooms in general.

THE courſe of nature in the production of muſhrooms has not been yet ſufficiently explained. Linnæus complains with reaſon, that the want of a due preciſion in their arrangement is the great opprobrium of the ſcience: perhaps what is ſeen in this and the other parallel inſtances, may lead to the better underſtanding them.

That

That muſhrooms produce ſeeds is now well known; and they are in this peculiar ſpecies very conſpicuous. From thoſe ſeeds other muſhrooms are produced, as in all plants; and there is the ſame diſtinction among muſhrooms as other vegetables, ſome being annual, and others having perennial roots. As among plants, ſome will live only on a dry, and others on a moiſt ſoil; ſome on clay, ſome in water, and others among gravel; ſo among the muſhrooms each has its appropriated bed, out of which it will not grow; and even upon which it will not arrive at perfection without a concurrence of other circumſtances.

The annual muſhrooms riſe, and when they have perfected their ſeeds periſh like annual plants: no part of them remaining but the ſeed which retains the principle of life to the next ſeaſon. The perennial rooted muſhrooms riſe in the ſame manner from ſeeds, and perfect ſeeds again: the muſhroom then fades, but the root remains and grows, as is the caſe in the perennial plants. The firſt is obvious in many inſtances; and may be ſeen diſtinctly in every paſture ground in autumn.

But

But tho' there are certain muſhrooms of the earth which have alſo laſting roots; this is principally the caſe with thoſe which grow on ſtones and trees: and the reaſon is plain. It is but by mere chance a ſeed of a proper kind of muſhroom can be brought into ſuch a place; and nature therefore gives the plant a laſting principle of life that it may continue there.

The ſeeds of muſhrooms are very ſmall and light; they are produced in vaſt numbers; and they become the ſport of winds: they float in the air like thoſe atoms we ſee in a ray of light received into a dark room; and millions periſh for one which falls upon a proper place for growth.

A common agaric which ſtands to ripeneſs upon the trunk of an old tree produces many millions of theſe minute ſeeds; which being diſengaged from its ſpongy ſubſtance when ripe, ride thus in the air. The greateſt part are loſt, and often all of them: for none will ſtrike root unleſs it falls upon a part of a tree where there is rottenneſs and moiſture.

When

When a ſeed is received into ſuch a place it ſhoots principally outward; and a muſhroom like the other is produced. This may be eaſily pulled off from the tree; and there is ſo little baſis or root to be ſeen, that it appears wonderful how the great bulk was fed. This is the caſe in the agarics of the firſt year; but it is otherwiſe afterwards: they adhere more firmly: they are difficult to be removed; and there appears abundant root for their nouriſhment.

In the generality of plants raiſed from ſeed, the part above ground, and the root increaſe proportionably to one another; and it is neceſſary they ſhould ſince the root is to ſupply the nouriſhment: but it is otherwiſe in the muſhroom kind. They are nouriſhed in a great meaſure from the air, therefore leſs root is neceſſary; and this part which is ſmall at firſt, increaſes afterwards, becauſe its great uſe is to continue the principle of growth for ſucceeding productions.

When a new-ſown agaric has ſtood to ripen, and has decayed undiſturbed, the root immediately increaſes. As ſoon as the ſeeds

areripe no more nouriſhment being required to the plant, all is employed there: the fibres enlarge and thicken; they ſpread out in breadth, and inſinuate themſelves into every crevice of the wood; and wherever they become expoſed to the air, they enlarge into a tough, firm, and irregular maſs which bears the injuries of the weather, and at a proper ſeaſon ſhoots up new agarics. Such a fungous lump is always produced where the firſt agaric was rooted, and wherever elſe the expanſions of the root are naked; and in all theſe places agarics riſe the ſucceeding ſeaſons; as alſo wherever the coat of bark is cracked or diſeaſed. This I have obſerved diſtinctly in two or three ſpecies of the true agarics; and probably it will be found the ſame in all that kind.

If the variety of nature in the production of other muſhrooms be regarded, there will be leſs cauſe to wonder at theſe. Ray names a peculiar kind which never grows but on a dead horſe's hoof: the French Memoirs deſcribe another ſpecies growing on the bandages of wounds and ulcers in their hoſpitals: and the Ephemerides of Germany, a

minute kind riſing from naked flint: nor is the growth of miſletoe, a perfect plant, from the branch of a living tree, leſs wonderful. The rudiments of the common muſhroom are almoſt univerſal on the dung of horſes, tho' they will not riſe to maturity unleſs it be covered with earth, and kept moiſt and warm. The old Greeks ſay, they may be obtained the ſame way from the bark of the poplar; and mouldineſs, which conſiſts of muſhrooms, is in a manner univerſal. The difference in ſize is of little conſideration; for the diminitive muſhroom that grows on dead leaves is as perfect as the cart-load agaric of Hungary.

ALL theſe ſpecies owe their origin to ſeeds of muſhrooms of like kind, which are utterly loſt when they fall upon ſubſtances improper to nouriſh them; and when they are received on ſuch bodies as can ſupport them, under certain circumſtances, they yet remain in form of roots, or imperfect rudiments till thoſe accidents occur which favour their full growth.

It is no otherwiſe in this muſhroom of the rock, ſtrange as its origin appears: ſeeds of the IMPERIAL MUSHROOM are received upon it, and like thoſe of the common kind on the dung of horſes they form a root; from which, in the ſame manner, when it is treated properly, perfect muſhrooms will riſe. What has given moſt the air of ſingularity to this is, that it was not obſerved muſhrooms might have perennial roots: but that is far from being peculiar to any one kind. Many of the muſhrooms which we ſee in woods, and which ſeem to riſe from the ground, grow really out of pieces of decayed wood under the ſurface; and theſe having perennial roots ſpread into the crevices of that dead wood, the ſame logs in thoſe circumſtances always produce them. While this dead wood lies on the ground, the ſeeds adhere to it, and ſpread their roots in it; but they do not grow perfect from it till it is buried.

Wood thus filled with the perennial roots of muſhrooms, may, eaſily, produce them, in the very ſame manner as the rock. A gentleman now in England aſſures me, he ſaw in the poſſeſſion of Mr. Trent at Rome, a

piece

piece of a root of a tree of the ſize of an ordinary billet, a preſent from the princeſs of Borgheſe, which being kept in a cellar and water'd, produced every two or three days a crop of excellent muſhrooms. This is a parallel caſe: the kind of muſhroom indeed was not the ſame, nor was the ſubſtance the ſame wherein the roots were lodged; but the proceſs of nature in their growth is perfectly ſimilar.

CHAP. IV.

Of the Growth of the Rock Mushroom.

ON this principle, and in this courſe, the growth of the rock muſhroom may eaſily be underſtood. As the proper ſeat of the agaric is in the cracks of rotting wood, that of the rock muſhroom is the cleft or crevice of a ſtone. One of theſe ripens upon the Piedmont hills, or elſewhere, where the proper ſtones are found: its innumerable ſeeds are ſcattered in the air, and ſome of them lodge in the cracks of this ſtone.

From ſuch ſeed a muſhroom like the firſt is produced; which ſtanding its due time upon the ſtone decays. Then the root begins to grow; it ſpreads over the ſurface; it runs into the cracks; and in fine, it covers the whole externally, and ſurrounds all the particles within, with a tough ſpungy ſubſtance. This is the proper baſe of future muſhrooms of the ſame kind; and is in all reſpects like the roots of perennial plants whoſe ſuperficial parts, ſtalk, leaves, and the reſt decay, but whoſe roots remain ready under proper circumſtances to produce thoſe plants again.

The ſtones may be carried into other parts of the world; and with tolerable care the root will remain unhurt, for it is very well defended: in this condition that was brought into England which is now in poſſeſſion of the noble Lady, who gave me opporportunity for theſe experiments; and the root being in a ſtate of growth, only a proper management is required to produce the muſhrooms.

CHAP.

CHAP. V.

Of the Management of the Mushroom-Stone.

THE muſhroom-ſtone when thus received is to be brought to produce them by a regular covering, and moiſture. A box or garden-pot muſt be provided of a bigneſs to hold it conveniently, and a hole being made in the bottom and covered with an oyſterſhell, about three inches thickneſs of dry loamy earth is to be put in; upon this the muſhroom-ſtone muſt be laid, and ſome good mould taken from under the turff in a paſture muſt be poured upon it to cover it an inch and half deep: it is then to be watered according to its bigneſs: from half a pint to a quart of water is to be allowed every other evening; and this muſt be given from a fine garden-pot. From the end of Auguſt to the beginning of November it ſhould be kept in the garden in a warm ſheltered place; and alſo from the beginning of March to the middle of May: and theſe are the ſeaſons in which

which it will bear the moſt, and fineſt muſhrooms: during the intermediate months it may be kept in a cellar; and it will there alſo yield occaſionally a great many. The quantity of water muſt be increaſed when it produces a large number, and diminiſhed when there are fewer. In cold nights a covering of dry ſtraw ſhould be laid over it; but no dung ſhould ever be brought near it. It is the peculiar quality of theſe muſhrooms not to require it; and they are therefore of a purer as well as a higher flavour than others.

IF the muſhrooms be covered with a handglaſs while they are taking their growth, they will be the larger; but the open air gives them a better flavour. Their great increaſe while under cover of a glaſs is owing to the conſtant moiſture about them; for I have obſerved they are in a great degree nouriſhed by the air: but the abundant wet debaſes their value.

THE rock-muſhroom is a peculiar kind; and it is conſtantly this ſpecies and no other which the Italian ſtone produces. It is not covered with gills on the under part, but pierced

pierced with innumerable little holes of a ſomewhat angulated form; nor does the head riſe to a point in the center, but ſinks inward. The common muſhroom reſembles a hat; but this a ſaucer or drinking-glaſs; and its ſtalk is not exactly in the middle, but nearer to one ſide. The upper part is of a mixed yellow and olive colour; and the ſurface is broke in a wild, but beautiful manner, into a reſemblance of ſcales and feathers. The under part is white; and in the pores lie the ſeeds. The ſubſtance of the muſhroom within is firm and white as ſnow; and it is of a delicate and high flavour, and is perfectly wholeſome.

All muſhrooms which are porous underneath belong to the Boletus kind, of which there are ſeveral ſpecies beſide this that are eſculent: tho' many of the ſame genus are nauſeous; and ſome poiſonous. The rock-muſhroom here deſcribed, differs from all the kinds hitherto treated of by botanical writers; and may be called, *Boletus ſtipitatus radice perenni, pileo depreſſo ſcabro, poris ſubangulatis.* The old inhabitants of Italy were well acquainted with its excellence: we learn

learn from Suetonius that Nero called it CIBUS DEORUM, the food of the gods; and the name IMPERIAL MUSHROOM, in the modern Italy, properly belongs to this rock-kind.

CHAP. VI.

OF THE INCREASE OF THE ROCK-MUSHROOM.

THE first notice I received of the mass, to which we owe the present observations, was on the nineteenth of June last: Lady STAFFORD did me the honour of acquainting me with it that evening. The rock had been some few weeks in her ladyship's possession; and there was then upon it the shoot of the first mushroom it produced while in that place: this was a thick oblong lump. From that day it continued increasing till the twenty-fourth, at which time I took it up; and it then measured six inches and a quarter on the head, and weighed one pound and two

ounces.

THE ROCK MUSHROOM.

H.

ounces. Lady STAFFORD who had herſelf obſerved it during the whole growth, with an attention and accuracy that would have done honour to a philoſopher, found by meaſuring it exactly every four and twenty hours, that it increaſed pretty regularly at the rate of an inch a day in the length, and nearly the ſame in the breadth of the head.

ITS form when perfect I have endeavoured to repreſent in the annexed figure; with its ſimple and peculiar fructification. See PL. II. A great deal of attention was uſed in gathering it to ſee in what manner it roſe from the rock. The mould was removed, and its inſertion made bare: it roſe from the plain ſurface of the ſtone by a thick and irregular baſe, which lengthened into a ſtalk, and thence proceeded to the expanſion of the head. No roots were produced from this ſtalk in that part under the mould: ſo that it drew no nouriſhment from thence; nor were there any roots iſſuing from it where it adhered to the maſs. The muſhroom conſiſted of an expanſion of that fungous ſubſtance which covered the ſtone: nothing more. Nor had it

any peculiar fibres: that whole fungous matter ſerved it as a root. The mould which is ſpread over the rock is uſeful in our management, and in the ſtate of nature equally, to detain the moiſture which is given it: and for no other purpoſe.

It has been long ſince diſcovered, that the gills in common muſhrooms contain the ſeeds; and in the ſame manner they are lodged in the pores of this kind. The parts of fructification are like the ſeed itſelf, extremely minute, but they are like thoſe of other plants in the eſſential articles; and the microſcope readily gives us a ſight of them.

The eſſential parts of impregnation in vegetables are two: the Antheræ, containing a fine duſt, in every particle of which is lodged a minute plant *; and the rudiment of the ſeed which is to receive it. In the more ſpecious plants theſe parts are ſurrounded with gaudy leaves, and there is a ſtyle which conveys the minute rudiment to the ſeed. In many of the ſmaller plants theſe appendages

* See Outlines of vegetable generation, Octavo.

and

and ornaments are wanting; but thofe effential parts are deficient in none. The antheræ are called the male organs; the rudiments of feeds the female: in the generality of plants both are contained in the fame flower, as in the tulip; but in fome the male organs grow on one part of the plant and the female on another: this is the cafe in the melon, where the organs of each fex, tho' feparate, are furrounded by a flower; and it is the fame in this mufhroom, where they are naked.

THE male part confifts of two filaments rifing from an oval bafe, and each terminated by its anthera: the female part is a naked rudiment of a feed crowned only with an indented rim, which ferves to receive and detain a grain of the powder from the anthera, till it burfts with the wet, and delivers the minute plant enclofed within it to the feed; where it is lodged fafely till it can grow.

BOTH thefe parts are contained within the pores of the under furface of this mufhroom;

many of them in every pore: and they are beſt ſeen in thin ſections of that part before the double microſcope. The male parts fall off as ſoon as the antheræ have burſt; but the female remain, adhering to the inner ſuface of the pores, till the muſhroom begins to dry: they then fall off and are ſcattered by the winds, and all periſh except ſuch as fall upon theſe ſtones, whoſe crevices afford them a proper reception.

CHAP. VII.

Of the Violet-Stone.

IT is uſual, indeed, that in purſuing one ſubject of this kind nature opens to us another: and it may not be foreign to the preſent ſubject to enter upon an article of natural hiſtory, as ſingular, and hitherto as little underſtood as this, which the ſame enquiries may perhaps explain; and which may be found very intimately connected with it.

The

THE muſhroom-ſtone has been underſtood as a body of the mineral kind, and what is called the violet-ſtone, as another. This laſt is not ſo named from its producing violets, but from its having a ſmell reſembling thoſe flowers. The German naturaliſts have called it LAPIS VIOLACEUS, and LAPIS ODORE VIOLÆ.

ANY ſcent in a mineral not bituminous would be ſtrange; and in an abſolute ſtone moſt of all. The account always appeared ſtrange to me; and I employed the correſpondence with which I was favoured in the HARTZ, to enquire into the fact, and tranſmit me ſpecimens. I received two: one a ſparry, and the other a harder ſtone, whoſe baſis was cryſtal, both covered on a part of their ſurface with a coat of a fungous ſubſtance, very like that of the rock-muſhroom; See PL. I. fig. 3. and in colour reddiſh. They had at this time no ſmell; but the account which came with them aſſerted, that they were fragrant when firſt taken from the ground. 'Twas evident the ſtones could not have afforded this ſcent; for they were of utterly different kinds: and there remained only this coat of vegetable matter

matter to yield it. Micheli and Guettard, Linnæus and Van Rayen, all deſcribe a German moſs, a Byſſus as they name it, which grows on ſtones that have been thrown ſome years out of the mines: Micheli ſays this has the violet odour; and Linnæus gives the Jolithus of Schwenkfield as one of its ſynonyma.

WHAT theſe authors name a Byſſus, and conſider as a plant of a different claſs, I have great reaſon to believe is the perennial root of the rock-muſhroom. If they had met with opportunities of examining the muſhroom-ſtone, ſuch as I have been favoured with, I think they would have found what they call a moſs in this inſtance, to be exactly of the ſame ſubſtance and contexture with the external covering of that maſs, which I have ventured to call the perennial muſhroom root: nor is the muſhroom-ſtone, deſtitute of fragrance, tho' it is perceived only occaſionally, as it is in what is called the violet-ſtone. I have obſerved that at certain times, and particularly in the evenings of hot days, when the ſtone at lord STAFFORD's has been newly watered, that as I ſtooped down to the

box

box I perceived a fragrant and aromatic ſmell. Not imagining the ſtone poſſeſſed this quality, I attributed it to a multitude of pinks which were then in full flower along the ſides of an adjoining walk; but a piece of the maſs which I cut off, and brought home with me had the ſame ſcent ſtrongly for two days. 'Twas evident therefore the fragrance was in the thing itſelf. Not in the ſtone, for that's incapable of it, but in the growing root of the muſhroom. The ſmell is a mixture of the violet and the clove-ſpice; and it went off gradually in the piece I had, as it dried.

THIS agrees with the accounts I received from Germany of what is there called the Violet-ſtone: for 'tis ſaid, that does not afford the ſcent at all times; nor all the pieces of it; that it has none when in the mine, and occaſionally diſcloſes it on lying in the air. This is abundant proof that the quality is not in the ſtone itſelf. The ſeeds of this muſhroom fall on it, and perhaps where the circumſtances do not favour for the growth of the perfect fungus, the vegetative power of

the

the ſeed ſpends itſelf wholly in forming this cruſt. Perhaps alſo compleat muſhrooms of this ſpecies may appear on ſome, tho' the too light attention of the obſervers does not ſhew them, they owe their riſe to that ſubſtance which they have ſuppoſed to be itſelf a perfect plant.

Thus the Violet-ſtone and Muſhroom-ſtone will probably be found, on more examination, to be no other than two ſtates of the ſame ſubſtance; and what has appeared ſo wonderful in their hiſtory will be found owing not to the ſtones themſelves, but to a vegetable ſubſtance which grows upon them.

The courſe of nature in their production appears to be this.

The ſeeds of the muſhroom here deſcribed falling on ſtones which are kept moiſt, by being in part immerſed in the ground, ſtrike root; and according to the various, more or leſs favourable circumſtances of the ſtone, they riſe to greater or leſs perfection. Where all perfectly favours, they produce at once a muſhroom like that from whence they ſprung, which

which after having ripened its feeds alfo, fpreads at the root, while the elevated part decays; and filling the porous fubftance of the ftone, as well as covering its furface, lies for years in this fecure place, as the roots of common agaric in a rotten tree; and is ready upon any occafion that favours, to fend up new mufhrooms.

When the fame feed falls on a ftone lefs favourable to its growth, it is not able to produce a perfect mufhroom, but rifes only into a coat or cruft of a fungous fubftance: and when there wants on the ftone whereon it has fallen both moifture and porofity, it forms even that coat imperfectly: inftead of a tough fungous fubftance it appears dufty or filamentous; and though it preferves a vegetative life in this ftate, it never can produce mufhrooms.

In all thefe conditions it is the fame fubftance, and the production of the fame feed;

and in all of them it has occaſionally ſomething of the violet ſcent.

In the firſt named ſtate it is called the Muſhroom-rock, and in the laſt the Violet-ſtone; and there is no wonder that its aſpect in that condition has been miſtaken by botaniſts; or the plant itſelf overlooked wholly by thoſe who ſtudyed minerals: it was too inconſiderable for the notice of the one, and too imperfect for the information of the other.

CHAP. VIII.

OF THE VARIOUS APPEARANCES OF THE MUSHROOM-KIND.

THAT Fungus's of many kinds as well as this are capable of retaining their vegetative power without their perfect form, is evident from numerous inftances. I obferved the *fungus fpongiofus maximus aqueus* of Dillenius four years in that fhapelefs condition, upon an old afh-tree near Denham; but the fifth feafon, on the tree's decaying farther, and more moifture lodging in the part, it fent out three perfect agarics, of that fpecies called by Cafpar Bauhine, *fungus angulofus pediculo exiguo*: and in this prefent year the *fungus tenuis niger ramofus* of Ray, at my own lodgings, fhot up four fine plants of the *fungus ramofus niger compreffus apicibus albidis* of the fame author.

We have inſtances of a like nature in other ſpecies, upon the credit of Buxbaum, which are beyond diſpute; and farther exact obſervation, I doubt not, will give more of a like kind in England.

In all theſe caſes we find, there may be circumſtances which will occaſion the ſeed of a muſhroom to ſhoot, and will keep it alive in the condition of an expanded root for many years, without ſhewing its diſtinct and proper form: and alſo that freſh occaſions will at any time bring up the perfect plants. Often ſhelter is wanting: often moiſture: and ſometimes air: of this there appeared in the year 1756, a particular inſtance at Westbourn-Green.

An agaric of the common great yellow kind grew annually from a wounded part of the ſtem of an old Elm: a fungous ſhapeleſs maſs covered the place the reſt of the year,

and flat roots ran from it between the bark and the wood downward. Thefe had not fhot out new agarics, becaufe they were covered; but fome boy in play having driven a large nail a little depth into the tree where thefe roots ran, the fucceeding autumn the rudiment of a new agaric appeared furrounding the nail; the root having pufhed out into growth all about it.

As I lived near the place I had opportunity to obferve the progrefs of this fingular vegetation; a perfect agaric was by degrees formed round about the nail; and it grew to maturity with the iron in its center

This may explain the appearance of common mufhrooms with a ftraw, or blade of grafs growing thro' them. It is not that the grafs has grown quick; and pierced them: the ftraw has no growth: it is that the mufhroom has arifen from fome part of a permanent root, which having been lodged near the ftraw

ſtraw, or the blade of graſs has grown round it, and encloſed it.

All theſe inſtances tend to the ſame proof: and even the ſubſtance which gardiners call the ſpawn of muſhrooms, and which they gather in paſtures where they have grown, is no other than an unſhaped and permanent part like thoſe we have named; which is ready under the favouring circumſtances of heat and moiſture, to ſhoot up perfect muſhrooms.

THE END.

A

NEW METHOD

Of PROPAGATING

FRUIT-TREES,

AND

FLOWERING SHRUBS,

From their Parts:

WHEREBY

The common KINDS may be raiſed more expeditiouſly; and ſeveral curious EXOTICS increaſed, which will not take Root from CUTTINGS or LAYERS.

Confirmed by ſucceſsful and repeated Experience.

By *THOMAS BARNES*,
Gardener to WILLIAM THOMSON, Eſq;
at *Elſham* in *Lincolnſhire*.

From Experiments propoſed by Dr. HILL.

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M.DCC.LXII.

A
NEW METHOD
Of PROPAGATING
TREES and SHRUBS.

CHAP. I.

The Occaſion *and* Purpoſe *of this Work.*

THE difficulty of propagating ſome ſhrubs in the common way, and the ſmall increaſe that can be made from others by the uſual methods, brought it into my thoughts to try whether ſome expeditious manner could not be invented of raiſing a large number.

EVERY NURSERYMAN will be glad to know this: for if he can, when he has got a new ſhrub, raiſe twenty or thirty inſtead of three or four, it will be a great increaſe for his profit: and in the ſame way, a GENTLEMAN, when ſuch a thing falls into his hands, will be better pleaſed to ſupply all his friends at once, than a few at a time, and not oblige all under the compaſs of many years. I thought the thing might be done, and that made me reſolve not to be diſheartened at one or two trials: and my honoured maſter has encouraged me, by giving me opportunities to make

 the

the experiments, and looking upon their progreſs himſelf.

It is about a year ſince I began the trials; and between that time and this, I have made them various ways upon four-and-twenty ſorts of trees and ſhrubs of the fruit and flowering kinds; not truſting to one or two ſamples of each, but uſing ſeveral dozens of every kind, and trying them in all the different conditions of culture, according to their nature, from the ſtove to the open air. By theſe means the experiments amounted to many hundreds; and as I kept a conſtant journal of them all, which I have here faithfully tranſmitted to the publick; every one will ſee how far each method ſucceeded, and which deſerves the preference.

CHAP. II.

Of Propagation *by the* Bud.

THE propagation of trees by layers and cuttings, ſhews, that if a piece of any kind be planted in the ground in ſuch manner that it takes root below, the upper part will ſoon furniſh all the reſt, and become a perfect tree. If roots can be thus obtained, the reſt follows in the courſe of nature. But this is not univerſal; for ſome trees will not take root in either of theſe ways: and if they would, ſtill the number is but ſmall that can be obtained by them, becauſe it is but a certain part of the branches a tree can ſpare for that purpoſe.

On

On examining the cuttings which have failed, I have always found that the mifchance happened by the rotting of that part of the cutting which was expected to fend forth the roots; for the danger is where it had been frefh cut, and has no bark to cover it. I thought it natural, that if a method were ufed to keep that part from decay, all thofe cuttings would grow, which we ufually fee fail: and communicating my thoughts to a gentleman of knowledge *, he not only confirmed my opinion by his own, but gave me a receipt for preferving the ends of cuttings from rotting; and defired me to try it afterwards upon fmaller pieces than fuch as are commonly ufed; and upon fingle buds.

Every leaf upon the branch of a tree or fhrub, has ufually a young bud in its bofom; and it is certain each of thefe buds has in it the rudiment of a tree of the fame kind: therefore it appeared reafonable to think that every branch might afford as many new plants as there were leaves upon it; provided it were cut into fo many pieces, and this fame dref-fing could prevent the raw ends of each piece from decaying. The advantage of fuch a practice appeared very plainly, for it muft give many plants for one, and the thing feem-ed fo agreeable to reafon, that I refolved to try it.

Many mixtures of refinous fubftances have been propofed on this head, under the names

* *Dr.* Hill.

of

of cements and vegetable mummies, by Agricola and others; but the very beſt, upon careful and repeated experience, I have found to be that juſt named, which is made thus:

MELT together, in a large earthen pipkin, two pound and an half of common *pitch*, and half a pound of *turpentine*. When they are melted, put in three quarters of an ounce of powder of *aloes*; ſtir them all together; and then ſet the matter on fire; when it has flamed a moment, cover it up cloſe, and it will go out: then melt it well, and fire it again in the ſame manner. This muſt be done three times: it muſt be in the open air, for it would fire a houſe; and there muſt be a cover for the pipkin ready. After it has burnt the laſt time, melt it again, and put in three ounces of yellow wax ſhred very thin, and ſix drams of maſtich in powder. Let it all melt together till it is perfectly well mixed; then ſtrain it through a coarſe cloth into a pan, and ſet it by to cool.

WHEN this is to be uſed, a piece of it muſt be broke off, and ſet over a very gentle fire in a ſmall pipkin: it muſt ſtand till it is juſt ſoft enough to ſpread upon the part of the cutting where it is wanted, but it muſt not be very hot. It is the quality of this dreſſing to keep out wet entirely. The part which is covered with it, will never decay while there is any principle of life in the reſt; and this being ſecured, nature will do the buſineſs of growing. This I have found true in practice: and by repeated trials, in more kinds than one, I have

found

Propagation by the Bud, and by the Branch.

found that I could raiſe from any piece of a branch, as many good plants as there were leaves upon it.

NOVEMBER the third, 1757, I took off four dozen leaves of the common LAUREL, with the Bud entire in the boſom of each leaf; and every thing being in readineſs, I cut the wounded part ſmooth, whiped it dry, and covered it with ſome of the dreſſing. I planted them in four pretty large pots, one dozen in each. The mould in theſe pots was made extremely fine; and I planted them by making very ſmall openings, and letting in the baſe of the leaf juſt ſo far that the top of the bud might not be wholly excluded from the benefit of the air. I gathered the fine mould carefully about each bud, and preſſed it every way cloſe, to keep the bud in its upright poſition, and prevent the air from coming too eaſily to the part whence the growth of fibres was to be expected. This was the management of the buds in all the pots.

ONE pot I ſet up to the rim in garden mould under a warm ſouth wall; another I ſet in the ſame manner, but without that ſhelter; the third I ſet in the green-houſe, and the fourth in the ſtove. The intent of theſe different places, was to ſee what effect ſuch variation would take in the growth; the ſtove naturally inclining all things to ſhoot ſooner.

I gave every one of them the ſame care and attendance that it was natural to allow to young plants; and no other. They had

waterings

waterings in the common courſe, and thoſe in the open air were ſheltered by peas-ſtraw in the ſeverity of the winter.

I examined them JANUARY the fourth. Every bud in the pot which was in the ſtove had formed a good plant two inches high, and with ſufficient roots.

THOSE in the open air were alive, but had made ſmall progreſs. I examined theſe laſt again APRIL the 12th, and almoſt all of them had made ſhoots, and had got good root, and were in a fair growing condition.

THESE plants require only the common care afterwards. They are to be removed into a nurſery-bed at ſeven inches high; and they will thus make, by a quick growth, ſo many handſome ſhrubs.

THUS I found that as many plants might be obtained as there were buds upon the branch. The experiment may be uſed to hardy trees of more value; and the benefit of it is very plain.

MARCH 5, 1757, I took off a branch of a white poplar, on which were a great many buds. I cut this into as many pieces as there were buds upon it, cutting the branch through at equal diſtances between every two buds. I thus had a great many pieces of it, each about an inch in length, with the two ends raw, and with a bud nearly in the middle between them. I ſmoothed the wounded ends of theſe, and having ſome of the dreſſing ready melted, I wiped them very dry, and ſpread it all over the cut part of each extremity, leaving the reſt of the piece, which was

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covered with the bark, naked. I planted them in pots in the ſame manner as the buds of laurel.

April 29, I examined theſe, and found they had produced ſo many excellent and healthy plants; every plant was upright, ſtrait, well-looking, and three or four inches high; and they had all very good roots.

It is eaſy to ſee how this experiment may be extended; and perhaps there are very few hardy ſhrubs which will not ſucceed happily by it. The laws of vegetation are the ſame, whether the plant come from an Engliſh ditch ſide, or the edge of an American lake; from the hills of one of theſe countries, or the mountains of the other: nor is there any reaſon to ſuppoſe thoſe from warmer climates will refuſe this courſe of propagation in the ſtoves wherein we keep them.

If this prove true upon experience, which I have happily found in ſome late inſtances, here is a method of increaſe which may be extended to all trees and ſhrubs that have buds, and we ſhall be able to raiſe much greater numbers, and with much more eaſe, than by any way that is yet known. It became me to try the experiment itſelf upon the eaſieſt objects, and ſuch as were moſt likely to ſhew its ſucceſs: for the enquiry was, whether this could be brought about in nature. Others may aſſiſt in the extending the experiments to more kinds: 'tis certain the principles of vegetation allow of it.

At the same time that I prepared these buds of the poplar juſt named, with the parts of the entire branch, I took off ſome others with only ſo much of the wood as was ſufficient to keep them entire; not cutting the branch through, but only taking the buds from the ſide of it with a ſmall piece of the bark and wood. I ſmoothed theſe parts, wiped them dry, covered them with the dreſſing, and planted them in pots, in the ſame manner, and with the ſame care as the others. They had all the ſame advantages, but the ſucceſs was not equal. Some of them made very good plants, but others failed: nor were the plants produced from thoſe which ſucceeded, nearly ſo fine as thoſe from the others.

From this Observation, I lay it down as a rule, ſo far as theſe experiments can ſupport a general maxim, that when buds are to be planted, it is beſt to allow them the whole thickneſs of the branch, however ſmall the piece may be.

I laid theſe pieces horizontally, with the bud uppermoſt; and the ſucceſs was as I have mentioned: it may be worth trying what would be the effect with the pieces planted perpendicular or obliquely, to give the bud a different direction from what it had in my pieces.

March 10, 1757, I took off ſome healthy branches of the common willow and the white willow: part of theſe I cut into lengths as the poplar, with one bud in the center of each piece; and from the other part

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I cut out the buds with a piece of the wood to each. I wiped the wounded parts of both dry, covered them with the dreſſing, and planted them in the ſame manner as the poplar in all reſpects.

The intent of this was to confirm the former experiment by other inſtances; and as the whole point was to try whether this power was or was not in nature, I again choſe ſubjects the moſt likely to ſucceed.

This experiment anſwered exactly as the former: all the buds which had pieces of the entire branches grew; and moſt of the others. It appeared plainly, that this power of producing trees and ſhrubs from ſhort pieces of their branches, in each of which there is a bud, is not repugnant to nature, nor limited to one kind: and this ſhewed farther, that the obſervation made in the other inſtance reſpecting the manner of the operation is true, namely, that the way to ſucceed beſt, is not to cut the buds out of the branches, but to cut thro' the branches, and allow each an entire piece, tho' it be ever ſo ſhort.

These were the experiments I made in the laſt Autumn, and the preſent Spring, in the propagation of trees by buds; and I invite and requeſt all Gardeners to join with me in proſecuting theſe trials upon ſcarce and otherwiſe valuable kinds.

Altho' this practice be new, it is founded in the moſt plain manner on reaſon and the nature of things. There is no more wonder that a bud ſhould produce an entire plant,

than that a ſeed ſhould grow. Each of theſe contains the rudiment of an entire plant of its kind, and there requires only a proper care in the culture to ſet it to growing. We do not wonder that the little lumps upon the ſtalks of the Dentaria, the White Saxifrage, or the Scarlet Lilly, ſhould grow when put into the ground; and there is the ſame reaſon that theſe buds ſhould, for they contain, in the very ſame manner, the originals of future perfect plants.

We do not enough regard the uniformity of nature; and it is thence our wonder riſes. But there is yet another inſtance in the courſe of the Gardener's profeſſion, which agrees more exactly with the growth of the bud, than either the ſeed or the little lump upon the ſtalk; this is the common claſs of bulbous roots. In all theſe what is called the bulb, is not a root, but a rudiment of a plant ſurrounded with a great many coats, or a thick ſubſtance, by way of defence from the injuries of the air. The roots of the plant are thoſe fibres which grow from its baſe. The bulb is formed every year, and a new one always ſucceeds that which had furniſhed the ſtalk and flower of the preceding ſeaſon. A bulb is an embryo plant, covered with films, and fleſhy matter, formed under ground upon the baſe of the root of a plant; a bud is an embryo ſhrub or tree, covered with films and ſcales, in the ſame manner, and formed in the free air upon the branches of the ſhrub. They are the very ſame in their nature and conſtruction; and in the end they

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are to ſerve. We ſee the bulb ſhoot up a perfect plant, without ſurprize; why then ſhould we wonder that the bud will have the ſame ſucceſs? Cuſtom has made the one familiar to us; the other at preſent is new; there is no other difference.

NOTHING could appear ſo ſtrange as the producing plants from cuttings, when Lauremberg firſt propoſed it to the world, yet what is now more familiar? The growth of cuttings is of the ſame nature with this which is here propoſed; and there is reaſon to believe, that the propagation by ſingle buds will ſoon be as common: and probably with proper care it will ſucceed as well in all other trees and ſhrubs which have buds of a proper kind, as in thoſe here inſtanced. Many trees and ſhrubs are deſtitute of buds entirely; indeed thoſe from the hotter countries almoſt without exception; and in others there are ſome buds which are deſtined to the production of ſome one part of the tree alone, not of the whole: therefore they will not anſwer the purpoſe. The Alaternus and the Oleander, the common Syringa, and the Tamariſk, the Savin and the Senſitive Plant, are inſtances, among many others, of trees and ſhrubs which have no buds at all, and therefore do not come within this courſe of propagation. The Alder has buds for leaves, which contain no rudiments of flowers, and therefore perfect plants could not be produced from them. In the poplar there are diſtinct buds for the flowers, and others for the leaves; therefore

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if the flower buds were taken, no succefs could be expected. The Hazel has its buds, containing leaves and female flowers: the Pine and Fir male flowers and leaves together: how thefe buds would fucceed, is a fubject of great curiofity, and is worthy trial: but in general, the bud of a tree contains the rudiment of the perfect tree, and therefore a perfect tree may be produced from it.

THIS is the ufual condition of buds, and therefore in the generality of kinds, trees may be produced by this practice with great eafe, and in great abundance. There is alfo, as I think, another very confiderable advantage from this method, though the limited number of experiments I have named, does not permit me to affirm it with all the certainty of the other facts. This is, that the trees produced from buds will naturally be handfomer and more vigorous than thofe raifed any other way, except from feeds: for in layers there is a great interruption of the courfe of the juices; and in cuttings it is uncertain whence the principle of growth will begin to act, fo that nature is difturbed in her progrefs, and the juices receive a check in their current, either of thofe ways; the effect of which in nature, we fee plainly in the growth of the Pine-apple, and many fuch inftances: whereas when the bud is planted, the fucceeding tree rifes ftrait from its natural place, and there is no turn given to the juices, nor any check in the growing. From the time the rudiment begins to grow, it

it continues growing; and while it lies in the bud, it is as much at reſt as the plant in the ſeed, till nature ſets it to ſhooting. Art does the ſame in this proceſs, and the effect is no way different; the tree grows juſt as the ſhoot would have grown on the branch. So many buds as there are on a tree, ſo many perfect trees of the ſame kind may be produced, if the Gardener takes care of them; for each is a young tree, and no other.

At a certain diſtance from the root, the rudiments of leaves, inſtead of forming ſeparate leaves, like thoſe below, coaleſce in their origin, and form a cup; and at the ſame time, and by the ſame power, whatſoever it is, (for 'tis hidden from us in itſelf, tho viſible in the effects) the rind and pith of the ſtalk, inſtead of continuing the growth in that form for the farther increaſe of the branch, break out into broad thin coloured parts and thready ſubſtances, and form the reſt of the parts of fructification: a flower is form'd, and ſeeds follow: that is, the plant ceaſes to grow in heighth and length of branches, for nature has given in that reſpect a certain law to all; and where its parts ceaſe to extend themſelves in length, they terminate in the rudiment of a new plant, called a ſeed.

This is the courſe of natural vegetation. Now art taking its place, produces from the ground that ſhoot, by planting the bud, which in the common courſe of things would have been ſent from the ends of the

the branches. It would have produced flowers and ſeeds when it had grown to a very ſmall length in that ſtate, becauſe the heighth of the ſtem, and the length of the branch whereon it grew, would have placed it at a due diſtance from the root: but when it is removed from this ſituation, and raiſed by planting the bud immediately in the ground, inſtead of forming only a ſhort branch, it produces an entire tree, becauſe the rudiments of leaves will never coaleſce into a cup, nor will the rind and pith form flowers and ſeed veſſels until the allotted diſtance from the root is once obtained.

LINNÆUS, who adopts from Loefling this doctrine of the ſtate of buds, ſays, He will give a great addition to the ſcience, who ſhall ſay what it is that influences the extremities of the plant to burſt out into flowers, and to form ſeeds. If I may offer my humble opinion, it is this: Nature has allotted to every plant, as to every animal, a certain growth or ſtature which it ſhould not exceed; and the cauſe of difference in that ſtature in various plants ſhe placed in their roots.

EVERY root, I imagine, has ſo much power as is neceſſary to carry up a plant to a certain heighth: then it ceaſes; and therefore there ends the immediate growth of the plant. When the branch can extend no farther, its parts all terminate; not abruptly, for that is not the courſe of nature in any thing, but each part, according to its kind, terminates in ſome one of the organs

gans of the flower, and the reſult of all is a ſeed; which being put into the ground will again grow and extend itſelf, becauſe it gets a new root.

The plant can grow no higher, becauſe its root can furniſh no more force for the aſcent of ſap; but the termination of the parts is by a ſeed, that is a rudiment, which muſt be put into the ground, and will then get new root, and therefore grow again.

Art, and the practices of the gardener, may interrupt and diſturb nature in theſe operations, and produce vegetable monſters; but this appears to be her regular courſe; and thus it is that a bud, which if it had opened on the tree, would have produced only a ſhort flowering branch, will, like the ſeed when planted in the ground, grow to the heighth of the original tree: for the power of the root it gives, is ſufficient for that purpoſe.

A root is required for this, becauſe only the power of that organ can extend and increaſe the parts; but nothing more is wanting; for roots, like the polypes and certain worms, have power even when cut to pieces to re-produce the ſeveral parts.

From theſe conſiderations may be underſtood all that appears wonderful in the production of plants from the bud, and conſequently from their other parts: and we ſhall ſee that what appears to be production or propagation, from the parts in general, is the ſame thing under another form: and that the raiſing plants by cuttings, is another

way of operating by the bud, though not ſo regularly. If this be proved, it is certain that the taking a bud itſelf will be preferable to the ſetting it loaded with a part of a branch. The rudiment of a root will ſtrike more readily, when the bud wherein it is contained is placed immediately in the ground; and the courſe of the ſap will be plainer, ſhorter, and eaſier, than when it is to run through a long though uſeleſs branch. This is in ſome degree reducing the Gardener's art to its principles; and we ſhall always ſucceed the better, the more perfectly theſe are underſtood.

If it be true, according to theſe remarks, that a bud is nearly of the nature of a ſeed, there can be no doubt of its ſucceeding the better, the nearer we bring its management to the ſeed culture. Indeed there is in nature ſomething like an inſtance of it in the plant *Biſtort*. This produces bulbs upon the ſtalk, which are a kind of buds; and theſe uſually fall off, and take root; but ſometimes they will ſhoot upon the ſtalk. In the firſt caſe they produce perfect plants of the ſame kind, but in the latter always poor, irregular, and imperfect ones.

CHAP. II.

Of the dreſſing of cuttings with this cement.

HAVING ſeen the good effect of this dreſſing upon the wounded part of theſe pieces of branches; that it certainly prevented

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their rotting in the ground, and by that means gave nature time to operate in the upper part of the branch; I refolved to try its effect upon fome cuttings of thofe tender exotics which are found commonly to fail. It appeared to me, that the only caufe of this was the rotting of the lower part of the cutting; and confequently, that if this dreffing could prevent that, it would fecure the growth of the fhoot.

Mr. Miller, in his Gardener's Dictionary, fays, "Some have afferted the coffee-"tree would grow from cuttings; but that "in all the different trials he had made, he "never could obtain one plant that way." Nobody will doubt this author's experience, or that he knew how to manage his cuttings perfectly well: for this reafon I fixed upon the coffee-tree for the kind I fhould firft try in my new way.

November the third, 1757, I took off fome cuttings of the coffee-tree in the ufual way; I wiped the wounded part very dry, and dreffed it with fome of the cement juft melted fo as to run. I planted thefe cuttings in pots in the common way, and fet the pots up to the rim in the bark bed in the ftove.

As this was a point of importance, as well as curiofity, I did not think it juft to rifk the whole upon one trial; therefore,

November the 28th, I took off fome more cuttings from a coffee-tree, dreffed them with the fame care, and planted them in the fame manner

manner in pots, plunging them into the bark bed in the ſtove.

April 20, I examined theſe cuttings, and found they were in a very healthy condition.

May 16, I again examined them, and they had ſhot ſix inches in heighth, and had got very good roots.

On the 12th of December I took off ſome ſlips of the coffee-tree, wiped the wounded part, and dreſſed them with cement. I planted theſe in the ſame manner as the cuttings, and gave them the ſame care; they ſucceeded as well, but not at all better than the cuttings. They all furniſhed very good and healthy plants.

From theſe experiments it appears, that thoſe tender and precious ſhrubs and trees, which will not grow in the common way from cuttings, may be brought to ſucceed in this manner: and this is a very conſiderable uſe of the dreſſing here deſcribed. It is a nice and difficult article to hit the right ingredients and juſt proportions: many have failed in various operations, who uſed ſuch mixtures as were ill made up; but ours will certainly anſwer this and the former purpoſes, as well as many others, to be named hereafter.

That this effect of the dreſſing upon the cuttings of tender plants, might be confirmed or refuted by more inſtances,

April 17, I took off ſome cuttings of the orange and lemon trees in the common method uſed in cuttings: I wiped the raw ends very dry, and dreſſed them with the cement.

I planted theſe in pots, and plunged them in the bark bed in the ſtove.

May 28, I examined them, and found they had began to ſhoot.

June 20, they had ſhot three or four inches, and got very good roots.

April 6, to confirm this practice by another inſtance, I took off ſome cuttings of the Double Oleander: I wiped the wounded parts, covered them carefully with the dreſſing, planted them in pots, and plunged them in the bark bed in the ſtove.

May 29, I examined theſe: they had all done very well; every cutting had ſhot ſix inches, and they had all got very good roots.

April 12, 1758, I took off ſome cuttings of the coffee-tree, wiped the raw part dry, and covered it carefully with the dreſſing; I then planted them in pots, and plunged them in the bark bed in the ſtove.

May 30, I examined the pots; I found every one of the cuttings had formed a good and thriving plant: they had ſhot ſix inches in length, and had got good roots.

These experiments ſhew, that the dreſſing agrees equally well with the generality of plants, preſerving the lower part from decay, and by that means giving nature an uninterrupted courſe for the nouriſhment of the ſhoot above, and time to ſend out roots from the part below in the ſame manner; for when nouriſhment is received, and the vegetable principle is unimpaired, the ſhooting of roots from the part below the ſurface,

is as natural as the ſending out of branches from above.

IT is plain this uſe of the dreſſing may be of great benefit, ſince it will cauſe many plants to ſucceed by cuttings, which would not otherwiſe do that way at all; and will make others ſucceed freely and generally, which without this aſſiſtance would anſwer but ſeldom, and at the beſt but poorly. The preventing the decay of the bottom of the cutting is the great article; for when that rots it deſtroys the whole. The decay of this is like a mortification in animal bodies, as ſoon as it has ſeized the part, it ſpreads and infects, and deſtroys all.

THIS decay in cuttings is occaſioned by the moiſture of the ground which affects the raw parts; but if that be guarded from the miſchief, nature does all the reſt. The Gardener need only prevent the decay of the cutting, the growth will follow without his aſſiſtance.

BUT though the effect of the dreſſing for this purpoſe is general, it is not univerſal: though it will anſwer with moſt plants, it will not do with all. This I have found by the like experiments, and it becomes me to acknowledge it: phyſicians have done the world as much ſervice by giving accounts of diſeaſes wherein remedies failed, as of thoſe in which they ſucceeded; and I would not ſerve this cauſe, even by ſilence, where it failed.

APRIL 19, I tried it on the ſenſitive plant. I took off ſome cuttings with great

caution, being ſenſible how difficult it would be to make them ſucceed: the pots were ready with excellent mould, and the dreſſing on the fire; I wiped the raw ends dry, covered them carefully with the cement, and planting them with all poſſible care, plunged the pots into the bark bed in the ſtove. They all died.

WILLING to make another trial, that I might be ſure wherein this method failed, as well as where it ſucceeded, on the 28th of MAY I dreſſed another parcel of cuttings of the ſenſitive plant in the ſame manner, uſing, if poſſible, more caution than at firſt, that they might have every poſſible advantage. JULY 29, I examined the pots, and theſe were alſo all entirely dead.

IN experiments on raiſing the ſenſitive plant by cuttings therefore, this method fails; but it is the only plant on which I have hitherto found it ineffectual.

IT is plain therefore, that the uſe of this method will be extremely beneficial, not only for the raiſing plants from buds, but alſo from cuttings. That ſtrange writer, Agricola, who firſt propoſed this kind of propagation, has diſgraced his work by many falſhoods; and for that reaſon, what was true and uſeful in it, was long neglected; neither had he the ſecret of a good cement, nor the great advantage of ſtoves: ſo that while, on the one hand, he has ventured to aſſert much more than is true, on the other he had not opportunities of knowing all that could be done by it.

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THAT author has aſſerted that trees may be produced from leaves. He ſays, the tender part between the ribs decays, and the fibres grow up into branches: he has even given relations and figures of orange and lemon trees, and many others, which he ſays he raiſed in this manner. Though there was little probability of truth in theſe accounts, yet being upon the ſubject, I reſolved to give this alſo a fair trial, uſing on ſome leaves of each kind the cement he directs, and on others my own. The reſult will be found in the following chapter.

CHAP. IV.

EXPERIMENTS *on* LEAVES.

NOVEMBER 3, 1757, I picked four dozen healthy leaves of the common laurel: I took them carefully from the tree, with no buds joining to them: I ſmoothed the end when they were pulled off with a ſharp knife, wiped it dry, covered it with the dreſſing; and thus preparing them all, I planted them in four middle-ſized garden-pots, one dozen in each. Two of theſe were expoſed to the air, the one under a ſouth wall, the other without that ſhelter, and both ſet up to the rim in mould; a third I ſet in the green houſe, and the fourth pot I plunged in the bark bed in the ſtove. This laſt place was choſen to promote the ſhooting of the fibres, nothing having ſo great power for that purpoſe.

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THAT the determination of this point might not reſt upon one ſet of experiments made at only one ſeaſon, APRIL 12, 1758, I took off two dozen more leaves of laurel, with the ſame precaution: I dreſſed them in the ſame manner, and planted them in a ſhady border.

MAY 29, 1758, I took off a third parcel of laurel leaves, and dreſſing them as the others, planted them alſo in a ſhady border.

AT the ſame time I examined thoſe of the NOVEMBER planting, and found them all dead in all ſituations.

APRIL 19, I took off ſome healthy leaves of orange and lemon trees; cut the raw ends ſmooth, wiped them dry, covered them with the cement, and planted them with all poſſible care in pots of good mould, and plunged them in the bark bed in the ſtove.

FROM time to time I gave theſe all poſſible advantages for promoting their growth.

MAY 29, I examined them; they were all dead, without any attempt to ſhoot out fibres.

MAY 30, I ſelected another parcel, prepared and planted them with the ſame care, and gave them all the poſſible advantages for growth.

JULY 29, I examined them, and found them all dead; no one having made any attempt to ſhoot out any fibres.

THAT this might not reſt upon one ſpecies in the ſtove, I determined to try alſo the coffee-tree.

APRIL 27, I took off ſome very fine and freſh leaves from a healthy coffee-tree, ſmoothed the raw ends, covered them with cement, and planted them in pots. I ſet theſe in the bark bed in the ſtove, gave them all the ſame advantages with the others, and on ſearching them, MAY 30, I found them all dead.

DURING the courſe of this experiment, on the 16th of MAY, I took off another parcel of the coffee-leaves, dreſſed them with the ſame care, and planted them in the ſame manner.

JUNE 27, I examined them, and found them all dead.

ALL this time the laurel-leaves of the ſeveral Spring plantations remained in the ground; and I beſtowed on them the common care, being determined to omit nothing that might give fair play to the experiment; nor to take up any leaf till it ſhould be evidently dead.

AUGUST 26, 1758, I examined carefully thoſe leaves which had been planted in APRIL, MAY, and JUNE, removing the mould a little from them. It is certain ſome of them have ſhot a few fibres from the lower part of the foot-ſtalk. What will be the reſult, is impoſſible to ſay; the proſpect of ſucceſs is very little; but the queſtion is not fully decided.

Since this I have found by trials at Bayſwater that Lady ſmock will grow from the leaf, and there are ſome others.

J. HILL

CHAP.

CHAP. V.

Of Propagation *of* Trees *by parts of the* Roots.

FROM the ſucceſs of the method of propagation by ſmall pieces of the branches of trees, it is natural to conceive that ſmaller or larger pieces of the roots will anſwer the purpoſe; and the ſame author who has treated of the laſt experiment, mixing truth with falſehood, has named alſo this.

Reason is very fairly on the ſide of the experiment. We ſee that roots, wherever they reach the ſurface of the ground, ſhoot up into young trees; and we find, by manifold experience and obſervation, that the difference between roots and branches, is little more in nature, than that the one are buried under ground, the other kept above it. This new method of propagation depends upon one principle, namely, that the rudiments of new plants are lodged in all parts of the old, and are ready to grow from them to perfection, whenever they have proper advantages. Therefore it ſhould appear to reaſon, that if a piece of a root can be kept from decaying in the earth, it will produce one or more new plants. This I propoſed to try by the following experiment:

November 3, 1757, I raiſed carefully by opening the ground, a large horizontal root of the Willow-leaved Buckthorn. I

trimmed off all the ſide ſhoots; and cutting the two ends ſmooth, wiped them perfectly dry, and covered them with the dreſſing all over the raw parts; not only the two ends, but the ſeveral places alſo from whence I had cut the ſide ſhoots and large fibres. I opened a trench in a bed in the nurſery long enough to receive the whole piece, and laid it in horizontally, and covered it an inch deep with mould, not raiſing a ridge over it, but keeping the place on a level with the reſt of the bed.

April 12, I examined this ground, and found a great many ſhoots riſing up at different diſtances from the whole length of the root.

April 30, many of the ſhoots have got ſix inches high, and all appear very vigorous.

May 20, ſeveral of the ſhoots are a foot long, and promiſe to make very ſtrong and fine plants.

June 27, I took up the entire root, and cut it into as many pieces as there were good ſhoots: thus every young plant had a piece of the large root for its baſe, and a multitude of ſmall fibres newly ſhot.

I wiped the two raw ends of every piece, covered them carefully with the dreſſing, and juſt trimmed the extremities of the new fibres.

I planted them in a ſhady border in the nurſery, and occaſionally watered them. I have ſo many fine plants. Theſe ſeemed in danger at the firſt removal, and I believe it would

would be better hereafter, when plants are thus raiſed, to let them ſtand till the next Spring before they are moved.

To try whether the roots of trees would not produce new ſhoots as well when cut to pieces, as in the entire length,

NOVEMBER 3, the ſame day with the firſt experiment, I took up another root of the ſame ſhrub, and cut it into pieces of two or three inches in length; I ſmoothed the raw ends of each piece, took off the ſide ſhoots, and covered the two raw ends, and all the ſmall wounds made by taking off the fibres, with the dreſſing. I planted them, at the ſame time, with the entire root in the nurſery, and gave them the ſame care. The ſucceſs was the ſame.

JUNE the 28th, they had all ſhot up one or more new plants. I took them up, took off all but the beſt ſhoot, and planted them in the nurſery, where they are now growing. That this experiment might not reſt upon one trial, or ſeem appropriated only to one plant; on the ſame day, NOVEMBER 3, 1757, I took up two roots of a Virginian Acacia, which was in good health, and could ſpare them without danger. One of theſe I dreſſed entire, the other I cut into pieces of two or three inches long; and covering all the wounds with the cement, I planted them in the ſame manner as the others, in an open part of the nurſery, laying them lengthwiſe in a ſhallow trench, and covering them an inch with mould.

In frosty weather I threw a little peas-baulm over the ground.

April 24, I examined the ground, and found young plants rising from almost all the small pieces of the root, and a great many from the entire one.

May 20, I had from these roots a great many fine plants of a foot or more in height.

June 27, I took up the large root, and cut it into as many pieces as there were good plants; I wiped these dry at the ends, and covering them with cement, planted them out in the nursery. They succeed very well; but required care at first. It will be best to let these plants all stand till the next Spring before they are removed.

To try whether the root would succeed best naked, or with the fibres about it, the same day, November 3, 1757, I planted a root of the Sallow thorn, and another of the Virginian Acacia with their fibres. These are no hindrance, and they appear to me to be an advantage. The great point is securing the root from decaying at the two wounded ends; for if that be prevented perfectly, nature will do all the rest.

The pressing down the mould about the root when first planted, is a very necessary caution; and in the course of the experiment, the place must be kept moist with due waterings. According to the more or less hardy nature of the shrub the root will require more or less shelter and defence in winter; and with this management there is no doubt of perfect success.

At the ſame time that I made theſe experiments on the roots of European and American ornamental ſhrubs, I was determined to try it alſo on fruit trees.

November 3, 1757, I took up two long pieces of the ſpreading roots of an apple-tree, beginning at ſome diſtance from the ſtem; and opening the ground all along, that I might get up the extreme part of the roots, with their ſmall diviſions. One of theſe I cut into lengths, and the other I left entire, not cutting off the ſide ſhoots or fibres from either. I ſmoothed the wounded ends with a ſharp knife, and covered them perfectly with the dreſſing or cement juſt made warm.

I opened a trench in a bed of the nurſery, and laid them in, covering them an inch over the upper part, with mould preſſed well down in every part about them. I allowed theſe the ſame care as in the former inſtances, and they ſucceeded as well.

April 7, 1758, I examined the ground; ſeveral young plants appeared both from the entire roots and the pieces.

May 20, 1758, many of the new plants had ſhot a foot high, and were very vigorous and promiſing.

July 27, I took up the entire root, cut it into as many pieces as there were good plants; and wiping their raw ends dry, covered them with cement, and planted them out in the nurſery.

They prove very good plants.

THE pieces of the root planted at the ſame time ſucceeded alſo very well; and having been tranſplanted into the nurſery, are now good plants.

AT the ſame time, NOVEMBER 3, 1757, I took up two handſome pieces of the root of a pear-tree, and managed them in the ſame manner exactly as thoſe of the apple-tree in the former inſtance. They were planted in the ſame manner, and had the ſame ſucceſs. That which had been laid in the ground entire, I cut in JULY into as many pieces as there were good plants upon it, and the others I trimmed of all ſhoots but one to each. The wounded parts I wiped dry, and covered with cement, and planting them in the nurſery with the common care, they are all now thriving plants.

THAT this experiment, which may be uſeful to Nurſerymen, and all who deſire to raiſe a great number of plants, might not reſt upon ſo few kinds, I extended it at the ſame time to ſeveral other trees and ſhrubs.

NOVEMBER 4, 1757, I cut off ſome roots of the Elm, the Oak, the Cherry, the Plumb-tree, the common White-thorn, and the Platanus: ſome of theſe I planted in the whole lengths, and others in each kind I cut into ſhort pieces, covering with cement the wounded parts, and planting them in the ſame manner as thoſe before mentioned, and the ſucceſs was alſo the ſame.

APRIL 30, I examined the ground, and found they had all ſent up vigorous ſhoots.

MAY

Propagation by the Root

MAY 26, moſt of them had ſhot a foot or more in length, and were very promiſing. Theſe I treated in the ſame manner as the preceding; and as many of them as I choſe to preſerve, are now fine plants.

I AM of opinion, however, in regard of theſe as well as the others, that if they had been ſuffered to remain till the next Spring before they were removed, they would have done better, and with leſs trouble.

CHAP. VI.

Of PROPAGATION *by large* BRANCHES.

THE ſame kind of reaſoning, which led us to believe that the roots, or pieces of roots, would raiſe young plants, being very naturally extended to the branches, I was determined to try what would be the ſucceſs upon experience. The difference between roots and branches being very little, the ſame method may be uſed for one as for the other.

NOVEMBER 12, 1757, I took off a branch of an apple-tree, and rubbed away ſo many of the buds, as to leave them only at three inches diſtance, or thereabout, and as much as could be all on one ſide of the branch. I ſmoothed the end, wiped it dry, and covered it with the cement, as alſo the places where the buds had been rubbed off. Thus prepared, I laid the branch in a trench opened in the nurſery, in a bed of good mould, and covered it an inch, preſſing the mould very well about it.

April 27, 1757, I examined the ground, and found a great many very fine plants coming up.

May 26, they had ſhot ſix or eight inches, and got good roots.

June 12, the plants being all very vigorous, I took up the branch, cut it into as many length as there were plants, covered both ends with cement, and planted theſe in a ſhady bed in the nurſery.

June 30, I examined the plants, by removing a little of the mould, and found they had got freſh root. They ſucceed very well; but probably would have done yet better, if left in the ground with the entire branch till the ſucceeding ſpring.

At the ſame time that I began theſe laſt experiments on the Apple-tree, I tried alſo the Pear.

November 12, 1757, I cut off a handſome branch of a Pear-tree, rubbed off a part of the buds, and ſmoothing the wounded end with a ſharp knife, I covered it with the cement, as alſo the places where the buds were rubbed off. I planted this in the ſame manner as the other, and with the ſame ſucceſs.

June 12, I took up the branch, cut it into as many lengths as there were good ſhoots, and planted them out in the nurſery, cementing firſt the two wounded ends. They are all now living, and are thriving plants.

To extend this experiment to other kinds of ſhrubs and trees, I made choice of the Sallow Thorn, Elm, and the Virginian Acacia. The reſult

result was different, and I ſhall give it ſeparately.

NOVEMBER 9, 1757, I cut off a branch of the Sallow Thorn, or Sea Buckthorn, rubbed off a part of the buds, ſmoothed the wounded end with a ſharp knife, and covered that part, and the places where the buds had been, with melted cement, I planted this in a trench in the nurſery, in a bed of good mould, as the others.

APRIL 7, ſeveral very good plants appeared.

MAY 20, I cut the branch into ſeveral pieces, each having a good ſhoot; and covering the two wounded ends with cement, planted them in another bed. They are all now good and healthy plants.

APRIL 20, 1758, I cut off in the ſame manner ſome branches of an elm-tree, and planted them with the ſame caution in a ſhady border of the nurſery.

JUNE 29, I examined the ground: they had all taken root, and there were a great many good ſhoots from them.

NOVEMBER 15, 1757, I cut off a good branch of the Virginian Acacia, ſmoothed off the wounded end, wiped it very dry, and covered it with melted cement. I planted this in the ſame manner, and with the ſame care as the other, covering the ground in froſts with peas-haum, and removing it when milder.

APRIL 30, I examined the ground; nothing was ſeen coming up; but on removing a little of the mould, the branch appeared to be alive.

JUNE 2, I examined it again: the branch was quite dead, and there had been no appearance of any ſhoot from it.

THIS method by the branches of trees, is but a different way of raiſing by the bud, but we ſee it is not univerſal; though it will ſucceed with the far greater part of plants. The Gardener may underſtand by this, that when he would try a new method of any kind whatſoever, he ſhould not limit his experiments to one ſort of plants, nor be diſcouraged at their failing in one ſpecies. It is plain, that the ſame method may be ſucceſsful in one inſtance which fails in others.

As to the branches and pieces of branches laid horizontally in the ground, they will thus produce plants of a good kind; ſo will at any time pieces of them, cut to a proper length, ſecured from rotting in the wounded parts, and placed in an erect poſition.

FEBRUARY 6, 1758, I cut off ſome ſhoots of an Apple-tree a foot long, and took a piece of the old wood with them, I ſmoothed the raw parts, covered them with cement, and planted them in a bed in the nurſery, at ſix inches diſtance, leaving only an inch of the ſhoot above the ground. I gave them the common advantages of new planted things, and watered the bed at times.

MAY 27, I examined theſe; they had all ſucceeded perfectly well; they had taken good root, and ſhot about ſix inches in height.

MARCH 7, 1758, I repeated the experiment upon ſome ſhoots of the Pear-tree. I cut theſe off, in the ſame manner, at about a

foot

foot long, and took a piece of the old wood with each. I ſmoothed the ends, covered them with the cement, and planted them in the ſame manner in a bed in the nurſery.

MAY 26, I examined them; they had all ſhot about ſix inches in length, and had got very good roots. They are now ſo many very fine plants.

THAT this experiment might not be limited to the fruit kinds, I choſe the common Elm for another inſtance.

FEBRUARY 6, 1758, I cut ſome ſhoots of the Elm in the ſame manner, with a piece of the old wood to each: I ſmoothed the raw ends, and covered them with cement, and planted them exactly as the others, in a bed in the nurſery.

MAY 27, I examined the ground, and found they had all ſhot five or ſix inches in height, and were ſtout and flouriſhing plants, having all good roots.

THIS tends to confirm the general doctrine upon which theſe experiments were all eſtabliſhed; which is, that any part of a tree which can be preſerved from rotting when in the ground, will ſend up a new plant of the ſame kind; and that the danger of decay is not in any of the parts covered with the bark, but only in thoſe which have been new wounded. It appears that the cement or dreſſing here directed, will preſerve thoſe parts; and therefore that by its means trees and ſhrubs may be produced from all their parts.

I SHALL cloſe this little work by a method not altogether of the ſame kind with theſe; but

but as it will ſucceed in ſeveral caſes, where the common way fails, it may not be unworthy of the notice of Gardeners.

CHAP. VII.

A Way of raiſing TREES *from the* ROOT.

TO raiſe a new plant from the root of thoſe kinds which will not take as layers, or grow from cuttings, I uſe this method: I lay open the earth over one of the roots of a thriving tree, of half an inch diameter, or more, according to the nature and growth of the tree: in ſmall and tender trees, ſmaller roots will do. I raiſe this out of the ground, cutting it two-thirds through, and trim off all the ſide fibres for about ſix or eight inches of the root: then I dreſs all the wounded parts with the cement juſt warmed, and keep the wounded part of the root for about five inches length out of the ground, ſupporting it by a forked ſtick.

THUS it has the advantage of its own fibres, and of the general vegetation and growth of the tree, all the time that it is thus kept up above the ground. It has been ſaid before, that the branches and roots of trees differ in nature no other way, than as the one are under ground, and the other in the open air; and therefore this part of a root being raiſed into the air, what grows from it will be of the nature of a branch or ſhoot, not of a root. The Spring is the beſt ſeaſon for doing this; and if due care be uſed, it will always ſucceed.

There

There will be young ſhoots produced from the part that is in the air. Theſe ſhould ſtand till the next Spring to be well eſtabliſhed, and they may then be cut off, and will readily and certainly ſucceed.

I HAVE raiſed in this manner plants of the Double Oleander, the Cotton-tree, and of ſeveral other kinds, the moſt difficult to be raiſed by the uſual methods of culture.

THUS have I laid down what experience has ſhewn me, upon frequent and repeated trials, relating to the methods propoſed by others, and uſed in my own practice, for raiſing valuable trees in abundance, and in an expeditious method; and I hope my brother Gardeners will find the advantage. They may indeed do much more; for though the experiments I have made amount to ſeveral hundreds, yet they have been limited to only a few ſpecies out of that almoſt infinite variety nature has thrown before us. Theſe experiments may be eaſily repeated, in theſe kinds, and new ones may be made upon the ſame principles. Perhaps alſo the few I have made unſucceſsfully, may, in the hands of ſome others, be crowned with ſucceſs; for nature is very various; the event of experiments frequently depends upon little circumſtances in particular caſes which are not ſeen; and which, though they have prevented it in one place, may not occur in another. Even the Senſitive plant may, perhaps, riſe from cemented cuttings under ſome other hand.

FINALLY,

Finally, the great queſtion relating to the growth by leaves, is not yet decided. I ſhall with care obſerve, and mark again thoſe which at the publication of this little work ſeem to give tokens of life, and ſhew ſome root. I ſhall alſo repeat the experiments on various other leaves, and hope others will join me in theſe trials. The thing ſeems ſtrange; but who can ſay, what is, or what is not, in the power of Nature!

F I N I S.

THE

PRACTICE

OF

GARDENING.

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The PRACTICE of GARDENING explained.

INTRODUCTION.

BOOKS of GARDENING are tedious; and difficult to be underſtood: and the beſt of them are very expenſive. They are beyond the reach of many a working gardener who wiſhes to improve himſelf; nor is it worth a gentleman's while, who raiſes a few flowers for his amuſement, to purchaſe them: neither would it anſwer either his purpoſe, or the others, if they did.

THESE writers in general are obſcure; for two reaſons: they do not chuſe to reveal the true ſecrets of their art; for they are not willing to make every body a gardener, tho' that is the pretence of their writing; and even where they are willing to be more candid, they expreſs themſelves in ſuch a manner that a common reader cannot underſtand them. They talk to thoſe who want to learn the buſineſs, as if they had already underſtood it; and therefore they are uſeleſs.

THIS is the reaſon why the practice of gardening ſucceeds ſo poorly, while it is pretended to be explained to every one: and for this reaſon the preſent ſhort account is publiſhed: which contains the whole without reſerve; and is ſo plain that any body may underſtand it.

CHAP. I.

The Division of a PLEASURE-GARDEN.

A GENTLEMAN who has a pleaſure-garden, ſhould conſider it under four articles. He is to have, 1. Hardy plants; and 2. Flowering ſhrubs; both which ſtand all the year in the borders: 3. Tender-annuals; which are to be raiſed in hot-beds, and brought into the common borders during ſummer; and, 4. Choice flowers, which are produced in ſeed-beds with great care, and afterwards planted in particular beds.

OF the firſt ſort, or hardy plants, that ſtand the winter, are *Campanulas*, *French honeyſuckles*, *Hollyhocks*, *Columbines*, *Sweet-williams*, *Wall-flowers*, and the like. Theſe are to be raiſed from ſeed in a nurſery, and brought into the garden the ſeaſon before they are to flower.

OF the ſecond kind, or ſhrubs, are *Roſes*, *Honeyſuckles*, *Lilac's*, or the like, which are to be raiſed from layers or cuttings, or from ſuckers, in the ſame nurſery with the hardy plants.

OF the third kind, or Tender-annuals, are *French* and *African Marygolds*, *Balſams*, *Globe Amaranths*, and *China-aſters*. Theſe are to be removed from one hot-bed to another; till the ſeaſon growing warm, and they gathering ſtrength, they are at length planted in the borders; and thrive as if they had been raiſed there from the firſt.

OF the fourth kind, or choice flowers, are *Auriculas's*, *Carnations*, *Tulips*, *Anemones*, *Ranunculus's*, and the like. Theſe are all perennial

and to have them in perfection, they muſt be raiſed from ſeed in a nurſery, and in due time brought into the garden.

UNDER theſe four heads may be comprehended the whole practice of common gardening; and as each claſs of theſe has a particular courſe of culture, the buſineſs may accordingly be divided into four kinds: 1. The raiſing tender annuals on hot-beds in ſpring. 2. The raiſing hardy biennials or perennials in the nurſery in the open ground. 3. The management of choice and curious flowers: which differs no way from the former, but in that it requires more time and care: and, 4. The propagating trees and ſhrubs, by cuttings, layers, or ſuckers. He that knows how to do theſe four things, is qualified to take care of any common garden; and when he rightly underſtands the culture of one plant of either claſs, he will know how to manage them all.

ANY plant in the world is reducible to one or other of theſe four kinds; and therefore all gardening may be compriſed within this moderate compaſs. Thoſe who have extended it to large volumes, have delivered ſeparately the culture of every ſpecies: but this is only repeating, many times over, the very ſame directions.

CHAP. II.

Of the Diſpoſition of a GARDEN.

BEFORE the care of raiſing plants, there naturally comes the proviſion of a ſoil for them to grow in. The garden muſt have good mould, and

and the proper conveniencies, elſe no art can give it beauty.

IF the borders be poor, bring in ſome old well rotted dung, mixed with ſome rich and freſh paſture mould, and a good quantity of that rotten earth which is found under old ſtacks of faggots. Theſe ſhould be well worked together, and then dug into the ground, in ſuch quantity as may appear neceſſary: more when it is poorer, and leſs when it is ſomething better.

LET the ground be open to the ſouth, ſouth-eaſt and ſouth-weſt, but well ſheltered againſt the north and north-eaſt. If former ill management has ſuffered trees or walls to thoſe quarters where it ſhould be open, let them be lopped, taken down or removed; and if there wants ſhelter on the other ſides, let it be given by a plantation of foreſt trees, or by walls.

THIS ground will feed and defend the choiceſt plants which bear the open air in our climate. The next requiſite is water. Ponds muſt be ſunk in proper Places; and theſe ſhould be ſhallow and clayed at the bottom. If nature has given ſuch, it is very fortunate; if not, they muſt be made. Any water will do that has ſtood ſome time in ſuch places; even pump-water itſelf: for it ſoftens with the air and ſun. In a ground of ſome extent, there ſhould be two or three of theſe; becauſe the labour of carrying water to a diſtance is very great, and when gardeners neglect it, the plants never thrive.

ALL that is required farther, is a nurſery, and a place for hot-beds. A piece of ground about

an

an eighth part as big as the garden, will ſerve for a nurſery; and one but half as big as that, will be ſufficient for the other purpoſe.

The nurſery ſhould lie to the ſouth-eaſt, and be well ſheltered from the cold quarters. It ſhould be hid from the garden, becauſe there is no beauty in it; and there ſhould be a little of the ſame enriching ingredients allowed to the mould in this place, that are uſed for the borders in the garden. It muſt not be ſo much; becauſe the plants will thrive better for being removed into a ſomewhat richer ſoil: but yet there ſhould be ſome. It is a cuſtom to let the nurſery have a very poor ground, but that is wrong; as extremes commonly are. Mr. *North* of *Lambeth* has a nurſery where the ſoil is very rich; and upon enquiry I find no plants ſucceed better than thoſe which have been brought out of his ground. On talking with that experienced nurſeryman, he gave me the following reaſons: That if the ſeeds be ſown in a poor ſoil, the firſt ſhoot will be weak; and when they come to be removed out of the ſeed-bed into a nurſery-bed, they are hardly able to get over the check of it: whereas if they are firſt raiſed in tolerably good ground, the original ſhoot is ſtrong, and the power of vegetation ſoon gets over the check of that and the other removals. This is agreeable to reaſon, and he found it true in many years practice: ſo alſo have I. In ſhort, ſuch as the firſt ſhoot is, ſuch the tree or plant will be; and the old practice of keeping a nurſery poor, is wrong. But moderation muſt be the rule; and though the mould

mould of this ſpot ſhould be good, it muſt not be equally rich with that of the garden.

THE aſpect determines where the nurſery muſt be placed; but the ſpot for the hot-beds muſt be choſen according to convenience. It ſhould be a warm corner of the ground, near the borders, though hid from ſight; and it muſt be alſo near the ſtable, or the place from whence the dung is to be brought. The cloſer it is to the borders, the eaſier it will be to remove the plants with good balls of earth to their roots; and they will always take the ſooner, the better the old earth is preſerved about them.

THERE is no piece of ground ſo ſmall, but this diviſion may be put in practice: and ſetting out right, all the reſt will be eaſy.

THE ground being prepared, we may proceed to the four methods of culture by which the plants are to be raiſed.

SECTION I.

The HOT-BED *Culture.*

THE flowers we raiſe for the latter end of ſummer and autumn, are moſtly natives of warmer climates, and their roots periſh in winter. They are to be produced every year from ſeed; and as our early weather is too cold for them, we are obliged to raiſe them with the aſſiſtance of heat and ſhelter early in the ſpring; that they may be forward in the beginning of ſummer, ſo as to flower in autumn: and after having decorated our garden for the two lateſt months, may ripen their ſeeds before the froſt nips their roots. This is the reaſon of the hot-bed culture, which is to be performed in the following manner.

CHAP. I.

The making of the HOT-BED.

THE hot-bed is a bed of mould warmed by the vapour of dung, and covered from the air by a frame.

THE mould ſhould be the ſame with that of the borders of the garden, but it muſt be ſkreened very fine. And the firſt care is this: In the month of January a ſufficient quantity of this fine mould muſt be brought into the hot-bed quarter, and laid in a heap. There will be required for theſe plants a ſucceſſion of three hot-beds; and there ſhould be as much mould firſt laid in, as will be ſufficient for them all.

THE frames are next to be prepared. The number and bigneſs of theſe muſt be proportioned to the quantity of plants intended to be raiſed; but care muſt be taken they are well put together; and that the glaſſes ſhut cloſe upon them. This will bring on the time to the middle of February, and the dung ſhould then be got ready, and the ground opened for the beds. Get in a good quantity of coal-aſhes ſifted, but not very fine, and ſave the cinders in another heap: then bring in three or four loads of dung, more or leſs, according to the ground. Let it come with the litter among it; and the wetter it is with the urine the better. Any dung of horſes will do, but that of high-fed coach-horſes is beſt. It ſhould be brought directly from the ſtable into the ground. As this is wheeled in, ſome of the ſifted aſhes muſt be ſprinkled over it. About

ſive pecks to a load of dung ſhould be thus added, and mixed in well among it.

WHEN all the dung is made up into a heap with this mixture, let it lye eight days to heat.

THEN mark out the place where the beds are to be made. Dig out the mould one ſpade deep in a long ſquare, of the ſhape of the intended bed, and lay that away. Throw ſome of the cinders into the trench, and ſpread them even with a rake to cover the bottom about two inches: then lay in the dung upon this bed of cinders: take it up with a fork, and ſhake every forkfull as it is taken from the heap. By this means the longeſt ſtuff will come firſt; and the ſhorteſt, which is the richeſt, will be left for the laſt, to make the top of the bed. Spread the litter even, as it is thrown into the trench, and beat it down well at times with the back of a ſpade, to make the long ſtuff lie cloſe and compact together. Raiſe the bed of dung in this manner about a yard high, and ſpread the ſmall ſtuff which comes laſt, and is almoſt all dung, evenly upon the ſurface.

Then bring on the mould from the heap laid up for that purpoſe, and cover the dung five inches deep.

CHAP. II.

The Management of the PLANTS.

THE bed being thus finiſhed, the frame muſt be put on, and covered with the glaſſes. Thus let it lie four-and-twenty hours to ſettle, and

and warm the mould: then lay the ſurface perfectly level, and ſcatter on the ſeeds moderately thick: the Balſam, Amaranth, China-aſter, and French-marygold, with the ſeveral other kinds, may be all ſown together; for the ſame management will raiſe them: but it is beſt to divide the bed into as many ſquares as there are kinds, by drawing ſlight lines over it, and in each ſquare to ſow one kind of ſeed.

When the ſeeds are all in the ground, ſome of the ſame mould muſt be ſifted carefully over them, till they are covered a third part of an inch. Some ſeeds require a little more depth than others; but this thickneſs in a hot-bed will anſwer generally for all. The glaſſes muſt be raiſed conſiderably in the day-time to let out the ſteam, and to let in freſh air, which is eſſential to the ſeeds growing well: in the night they muſt be ſhut down; but not quite cloſe, unleſs the weather be very ſevere indeed: and even in that caſe they muſt be opened again in the morning. The warmth and moiſture of the mould will ſoon bring up the plants, and then a new caution is required to preſerve them.

Where they have riſen very cloſe, ſome muſt be pulled up. By this time the extreme heat and ſteam of the bed will be abated: The glaſſes may be kept cloſe down all night; and there will require only a moderate raiſing of them for air in the warmeſt part of the day. Hot-bed plants require a different management at their various periods. In this ſtate they muſt be kept pretty cloſe, for they are in no danger of

being drawn up weak as yet; and the seed-leaves require but little air.

When the plants have a few days growth they will be fit for removing; and there must be another hot-bed provided for them: this should be considerably larger than the first, because the plants must stand farther asunder. Let the bed be made up in the very same manner, and let it be covered, five inches and an half deep, with the same fine mould as the first. Cover it with the frame, and shut down the glass, and let it stand three days, that this thickness of mould may be thoroughly warmed.

Then in the beginning of the afternoon remove the plants. Open small holes a finger's length deep in the mould, at three inches and a half distance every way from one another. Take up the young plants out of the first hot-bed with the point of a trowel, and immediately set them in this, one plant in each hole. Take care not to break the tender roots in taking them up; nor to double or crush them in setting them in: bring the mould carefully about them; and when they are all planted, give the whole bed a very light and careful watering: taking particular care not to beat down the plants: then close the glasses and leave them for the night.

About nine o'clock the next morning raise the glasses a little way; at noon cover them with matts that the sun may not scorch up the leaves, and raise them a little higher; toward evening wipe the wet off the sides of the glasses, that

that it may not fall back upon the plants, for it is always injurious to them.

In this bed they muſt ſtand about three weeks; and this muſt be their conſtant management: the glaſſes muſt be let down at night, and kept up always a little in the middle of the day. They muſt conſtantly be wiped before they are ſhut down for the evening; and the degree of opening during the day, muſt be more or leſs according to the weather. The plants muſt have as much of the free air as they can bear without hurt, and the tender kinds will ſoon ſhew if there be too much allowed them. If the mould grow dry, they muſt be watered gently and carefully.

The heat of this bed will decline gently at the end of about three weeks; and there ſhould, at that time, be ſome freſh dung laid to the ſides of it: for the plants are to be removed from this hot-bed to another, and the mould of this muſt therefore be kept in ſome degree of warmth.

The plants having been ſown in the end of February, will be by this time of ſome ſtrength; the ſeaſon will alſo be growing toward ſummer: another bed muſt be prepared for them about a week after the dung is laid about the old one; and this will keep them till they can bear the air. This laſt hot-bed muſt be made in the ſame manner as the firſt, but with leſs dung and more mould. It muſt be conſiderably larger than the former, becauſe the plants will require a much greater diſtance; and there muſt be a depth of mould for the roots. The dung of

this

this bed ſhould be about two foot in height, and the mould ſeven inches and a half deep.

WHEN it has ſtood covered one day and night, open holes in it at ſeven inches diſtance, and lay up the mould by the ſide. Take up the plants out of the former bed with large balls of earth about the roots; and ſet them in this with a great deal of care. Draw the mould about them, and give them a gentle watering. Cover the glaſſes with mats, and raiſe them a little in the middle of the day, but keep them cloſe at all other times till the plants have taken perfect root. Then let them be every day opened more and more at noon, and left open longer. If the plants be kept too cloſe, they will run up weak, and be ill ſhaped. In this bed they muſt ſtand till the latter end of May, and all that time they muſt be watered frequently. The glaſſes muſt always be ſhut down at night; and when the cold is ſevere, they muſt be covered with mats. The more air is let into them in the warm hours of the day the better.

TOWARD the end of May the hardier kinds may be removed out of this hot-bed at once into the borders of the garden; chuſing the evening of a mild day. Large holes muſt be opened for them, and they muſt be planted with great care. They muſt be taken up with a good ball of mould, and when they are planted again they muſt have careful waterings, from time to time; till they are thoroughly well rooted in the ground.

THE removal of theſe out of the hot-bed will give more room to the tenderer kinds which re-

quire

quire to remain longer in it: theſe muſt be thin'd where they are cloſeſt, taking up every third or fourth plant; and ſetting theſe immediately again in the parts of the bed left vacant by taking away the others. The new planted ones muſt be watered frequently, and all the reſt at leaſt once in the Day. The glaſſes muſt be opened more and more every day, but the top ſhaded with mats when the ſun ſhines upon them. After this hot-bed has been made and planted a fortnight, let ſome mowings of ſhort graſs, or any like matter, be piled up round the ſides of the dung: this will bring on a new warmth and fermentation, when that of the dung begins to decline: and it will be enough for keeping up the growth of the plants, yet ſo moderate, that they will bear removing afterwards out of the bed without danger.

When they have ſtood three weeks or ſomewhat longer in this bed, another parcel of them may be planted out into the borders. Chuſe the hardieſt of thoſe which are now left; ſo that only the moſt tender and delicate kinds will remain in the bed. Theſe muſt be taken up with more care than ever; becauſe being larger, they will be apt to receive a greater check in the removal: a large hole muſt be opened for each, and the plant muſt be taken up with a great ball of mould, and planted without injuring the roots. They muſt be watered frequently after this, till they are thoroughly ſettled in the new ground: for if they get a check in their growth at that time, they never make good plants afterwards.

wards. Frequent watering is the great article, but the ſeaſon may be a great advantage. The principal danger may be from the ſun; therefore they muſt always be planted in an evening, that they may have the night for ſtriking; and if a cloudy time can be choſen, it is much the better. The difference in this reſpect is ſo great, that they ſhould be planted two or three days ſooner or later, according to this accident.

THERE will now remain in the bed only the tendereſt kinds, and it will be time to get theſe into pots. A ſufficient number of ſmall pots muſt be provided, and they are to be filled with mould from the firſt heap; the leavings of which having been now ſo long expoſed to the air, will be much richer than the reſt; and very fit to receive them.

TAKE up the plants carefully one by one, and ſet them immediately one in each of the pots. This may be done in the bed by lifting up the glaſſes. As each is planted, let the pot be ſet up to the very rim in the mould of the bed. The beſt method is to begin by taking up the plants which ſtand next one end, and then opening holes along that end to let in the pots as they are done; placing them cloſe to the wood of the frame, and as cloſe to one another as they can ſtand; and filling up the ſpace between them with mould. This is to be continued till all the plants are potted; and if the pots be of a moderate ſize, they will in this manner fill the bed: there will be yet warmth enough in the dung to keep all in a due condi-

tion

tion for ſome time; and as this dies off gradually, the plants will be the more fit for the open air into which they are ſoon to be removed.

THEY muſt all be watered as ſoon as they are potted. This is to be often repeated afterwards; and they muſt be inured to the air. The glaſſes muſt be ſet open a great part of the day, but when the ſun is violent, they muſt be ſhaded with mats. In this bed they muſt be kept till the middle of July, defending them by the glaſſes from the cold of the nights; and giving them more and more air every day, till at length the glaſſes are to be taken entirely off in the middle of the day, when the weather is cloudy; and at laſt kept off entirely.

WHEN the plants have borne this ſome days, they will be in a condition to remove into the air; but this muſt yet be done with caution. A warm and well-ſheltered ſpot in the nurſery ſhould be choſen for them, and the earth dug away a ſpade depth. The pots muſt be brought out in a warm cloudy day; and it will be beſt of all if there be ſome rain. They muſt be ſet up to the rim in this bed, and the mould laid in cloſe among them. They muſt be watered every day; and they ſhould ſtand thus a week. Then the pots may be expoſed to the air by ſetting them upon the ſurface of the ground; and after this they may be ſet out in the places where they are to flower.

THEY muſt be watered every day, and they will now want no more care.

THIS is the method by which all annuals may be raiſed to their greateſt perfection. Leſs care is uſually taken, and therefore they ſucceed the worſe: But this is not much. A little trouble will ſerve a great many plants, and they will anſwer it very well in their beauty.

Two things farther are neceſſary; 1. The care of their flowering; and, 2. A proviſion for ſeeds. Both are too much neglected in common practice. Let the beſt plants be marked for ſeed; and let theſe be managed purpoſely for it. They muſt only be ſuffered to open ten or a dozen flowers: and when theſe are well ſet for ſeed, all the reſt that offer muſt be taken off in the bud. Theſe plants muſt be watered very often, but never a great deal at a time: and when the ſeed is formed, and has got its due ſize, they muſt be ſet againſt a ſouth wall where they can ſtand quiet; and they muſt then have no more waterings. When the ſeed is thoroughly dry and hard, it muſt be gathered and kept for the next ſpring. If this care be taken each year, the ſtock will increaſe every ſeaſon in beauty.

THOSE plants, which are intended only for bloom, muſt be treated in a contrary manner; they muſt be watered largely once a day, and no more: and all the flowers, as they begin to fade, muſt be taken off with a pair of ſharp ſciſſars. This keeps the root in vigour. For nothing exhauſts it like letting them ſet for ſeed: and the taking off theſe before that time, wil produce more and more freſh bloom. Whei the ſeaſon grows cooler, they muſt be removec

into a place of ſhelter to keep them in blow as long as that can be. When the froſt ſeizes the mould they will decay: but they will thus be preſerved longer than could be thought in beauty, and will produce four times the quantity of flowers that they would have done if managed in the common manner.

THERE is nothing in this that a gentleman, ever ſo much unuſed to gardening, may not direct a common labourer to perform: and theſe are the flowers which make the ſhew of autumn.

SECTION II.

The Culture of BIENNIAL *and* PERENNIAL *hardy Plants.*

PERENNIALS are ſuch plants as keep alive in the root during winter, and when once planted, are ſuppoſed to need little more care: but they may be made to flower much more elegantly with a little attention. The BIENNIALS periſh when they have flowered, tho' they are two ſeaſons in coming to that ſtate. The ſame culture ſerves for both.

OF the hardy perennial kind we have named the campanulas, hollyhocks, and ſeveral others. The moth-mullien is a biennial.

THE ſeeds of theſe will all ſhoot in the common ground; and they are all to be ſown in the ſame manner. Therefore this ſecond culture may all be delivered in as moderate a compaſs as the firſt.

CHAP. I.

Of preparing the GROUND *and ſowing the* SEED.

CHUSE out a piece of the nurſery that lies a little ſlanting from north-weſt to the ſouth-eaſt, and is very well defended from cold winds. Let it be of the common mould of the place; that is, of the ſame nature with that of the garden, but not quite ſo rich. Turn it up in ridges all winter, and in the beginning of March lay it all level; let it be well dug and raked, and then tread up a path along the middle, and divide the ground on each ſide into beds four foot and a half wide. The extent of this ſpot muſt be proportioned to the garden; but in this one place, and with one and the ſame care and management, may be ſown and raiſed all the common hardy perennial and biennial plants.

IN the middle of March let the ſeeds of the ſeveral kinds before named, and of any others that may be deſired, be ſown in this manner. Chuſe one or more beds for each, according to the quantity intended to be raiſed, and rake off about half an inch of the ſurface; then in the evening of a calm day ſow them thus: Mix with the ſeeds three times as much fine ſifted and dry mould; it will make them ſpread the more evenly. Sow them by hand with this mould pretty thick, and when the ſurface is regularly covered with them, ſift over them the mould that was firſt raked off from the bed. This will cover them a third of an inch, which will

be perfectly ſufficient. When the ſeeds are covered, lay two or three pieces of black-thorn buſh upon the bed to prevent accidents; and if in two days there does not fall any natural ſhower, water the ground. This muſt be done very gently, and the pot ſhould have a fine pierced noſe without flaws: for if the water run out in any part in a ſtream, it will waſh the ſeeds out of the ground wherever it falls. The buſhes need not be removed for this watering.

ALL the ſeeds of the biennial and perennial kind being ſown and ſheltered in this manner. The waterings muſt be repeated if the ſeaſon is dry; and when the plants appear, the buſhes ſhould be lifted off the ground. They will not be wanted any more; they have kept off accidental injuries, and mellowed the mould, and this was all that was required.

WHEN the plants have a little ſtrength, they muſt be thinned, by pulling up ſuch as are weakeſt, where they ſtand too cloſe; and they muſt have water whenever they want ſhowers. This muſt be managed with great care; for if the plants are injured now, they do not well recover it; and a heavy watering may bruiſe them, or waſh them out of the ground. They ſhoot up only leaves at preſent, for the ſtalk does not appear till the next year: but the rudiment of it is formed already; and if it be injured, the plant will never be fine afterwards. As the plants grow larger they muſt be thinned again, taking up always the worſt. The ſeed was ordered to be ſown pretty thick for this purpoſe, that there might be choice of the beſt to leave for growth.

If there be very ſharp winds when the plants firſt come up, and the ground is not well defended by its natural ſituation, a reed-hedge ſhould be ſet up to defend thoſe which are in moſt danger: and if hard froſts happen which break the ground about the new-riſing plants, a little mould muſt be ſifted over to cover them again; removing it with a finger when it would bury the heart of the plant.

Thus the danger of the early ſpring will be got over, and all the reſt will come very eaſy. The plants muſt be weeded carefully, and the ſhowers of April will water them.

In the beginning of May they muſt be tranſplanted; and for this purpoſe a bed muſt be dug up and levelled, much larger than the firſt. The evening of a mild day ſhould be choſen for this purpoſe; and if the weather be ſhowery ſo much the better: the gardener may very well wait for this opportunity, ſince a few days ſooner or later, will make no great difference.

Holes muſt be opened for them at different diſtances, three, four, ſix, or eight inches, according to the bigneſs of the plants. The roots muſt be taken up carefully, and immediately planted, and the mould muſt be drawn cloſely about them, and ſettled by a good watering.

During the ſummer the ground muſt be weeded as often as any growth of that kind is ſeen upon it. And ſome of theſe weedings may be done by hand, but one or two ſhould be with a trowel; breaking up all the ground between the plants at the ſame time that the weeds are deſtroyed.

If any of the plants ſend up ſtalks this firſt ſummer, they muſt be cut down cloſe to the ground, for it is not their flowering ſeaſon, and they will be weak and poor. The roots are to ſtrengthen themſelves in the ground this ſeaſon, and nothing more is required of them.

In the beginning of October, let more ground be dug up for them, and let them be there planted at a greater diſtance. About twice the number of beds the plants already occupy, will be needful for this ſervice: the ground muſt be dug up a full ſpade deep, and holes opened for the reception of the plants at double the diſtance of thoſe in the former bed. An evening of a mild day ſhould be choſen for the buſineſs, and the plants carefully taken up, each with a ball of earth. The extreme fibres muſt be trimmed when they are brought to the new ground, and they muſt be directly ſet in, and the mould cloſed about them.

Give them a ſlight watering that evening, and a large one the following morning: take off the large outſide decaying leaves, and the reſt will thrive the better. When the weather comes on ſevere, lay more thorn-buſhes lightly upon the beds, taking care not to cruſh down or wound the plants; and in the depth of winter, when there are hard froſts without any ſnow, ſpread ſome pea-ſtraw over the thorn-buſhes; taking it off again when the weather is any thing milder.

CHAP.

CHAP. II.

The Management of PERENNIALS.

EARLY the ſucceeding ſpring make a draught of the ſeveral kinds of theſe out of the nurſery-beds for the immediate ſervice of the garden; for the greateſt part of them will flower this ſummer. In all quantities of flowers raiſed from ſeed, there will be ſome better and ſome worſe, and no art can diſcover which will be good or bad, till the time of flowering is come: therefore for this firſt year the garden muſt ſtand its chance for good or bad; but in the following ſeaſons it will be ſupplied with certainty.

THE middle of February is the beſt time for making this plantation, for if it be delayed longer they will flower very poorly. With tolerable care there will be no fear of loſing the roots when they are put in thus early. Let a mild day be choſen; and if the ſeaſon be very ſevere, let it be delayed till the extreme froſt breaks: then mark the places in the garden where theſe plants are to ſtand, and open a hole for each a full ſpade deep; and a foot wide. Take up as many plants as are wanted out of the nurſery-bed; bring as much of their own earth with them as can be done conveniently; and ſet them upright in the holes with the head of the root a little below the level of the ſurface of the border: cloſe the earth well to them, and ſink a ſmall hollow about the head of the root. The ridge of earth round it will keep off the bleak winds; and if the weather ſhould

ſhould again ſet in ſevere, there may be a little bundle of dry pea-ſtraw laid over each plant.

The morning after the planting every one muſt have a moderate watering. At the time of planting there muſt be ſome given, but that muſt be very little. Theſe plants will require afterwards no other care than is taken of every thing elſe in the borders, and they will flower ſtrong and well.

The great article is the care of thoſe in the nurſery; for the principal expectation is there. The beds muſt be kept weeded; and in very dry weather the plants muſt be watered. They will flower at their natural time, and the gardener will then know the value of the roots.

No plant ſhould be ſuffered to blow more than four or five flowers this firſt ſeaſon: this will be enough to ſhew their excellence, and they ſhould then be cut down cloſe to the ground for ſtrengthening the roots. As they come into flower, the fineſt ſhould be marked by thruſting a ſtick into the ground near the root; and ſuch as are very poor ſhould be pulled up and thrown away.

In the beginning of October thoſe roots which are marked for having borne fine flowers, ſhould be taken up and brought into the garden. Large holes muſt be opened for theſe; and they muſt be taken up with balls of earth, and planted carefully. The ſucceeding year they will flower in their moſt perfect beauty, and the roots will have their full ſtrength.

It is this year alſo that the plants ripen the moſt perfect ſeeds, therefore the very fineſt ſhould

be marked for that purpoſe. The ripening of their ſeeds will weaken the roots, but it is needful for a ſupply; and thoſe which have been uſed for this purpoſe ſhould be taken up, and others planted for the next year in their place.

THOSE plants which are marked for ſeed muſt not waſte the ſtrength of the root by too much blowing; a few flowers will afford a ſufficient quantity of ſeed, and it will be much better, than when the plant is loaded.

THESE muſt be well watered while the ſeed is growing to its bigneſs; and after that they muſt have very little; and for the laſt days none.

WHEN the huſks are quite dry, the plant ſhould be cut up, and laid entire on a ſhelf in an airy room to harden. After a day or two the ſeed-veſſels muſt be taken off and laid ſeparate to dry a week: then the ſeeds ſhould be ſhook out; and theſe ſhould again lie about ten days. Thus they will be perfectly cured; and they ſhould then be put up for winter. The following ſpring they ſhould be ſown exactly in the manner before directed; and this ſhould be the courſe from year to year.

THE old roots will flower very well two ſeaſons more, but not equal to the firſt bloom; and much leſs to ſuch as ſhall be produced from the ſeeds of theſe. With the management here directed, the ſtock will be every year improving; and a very ſmall piece in the nurſery will ſupply theſe articles to the garden.

CHAP. III.

The Management of BIENNIAL PLANTS.

THESE agree ſo entirely with the perennial in all reſpects, excepting only their duration, that the ſame management exactly ſerves them, all but in the laſt tranſplantation. They are to be raiſed as the others by ſeed ſown in ſpring; and they are to be in the ſame manner tranſplanted out of the ſeed-bed into a ſecond piece of nurſery-ground; but they ſhould be brought in time into the garden. If theſe plants be kept all the ſummer in the nurſery-bed into which they were tranſplanted from the ſeed-bed, they will many of them flower in the nurſery, which is not intended; for they are not ſtrong the firſt year, nor is the nurſery a place for the flowering of thoſe plants whoſe roots periſh. To prevent this there requires one tranſplantation more the firſt year for theſe than for perennials.

WHEN they have been raiſed in the ſame manner with thoſe, and in the ſame manner tranſplanted out of the ſeed-bed into another part of the nurſery, they muſt not be ſuffered to ſtand there till autumn, but brought into the garden during the forepart of ſummer. They will naturally be removed out of the ſeed-bed in May; and when they have ſtood about five weeks in the new ground, it will be proper to take them into the garden. This muſt be done with care; and it will ſecure their continuing without a ſtalk till the next year. Toward the latter end of June let a cloudy day be choſen,

and open, in the borders of the garden, as many holes as there are plants. Take them carefully up with a good ball of earth to the root, and fix the new mould well about them. Give them a good watering; and repeat it every day: they will ſtrengthen themſelves by this means during the ſummer and the winter following; and having had eighteen months growth before they flower, they will blow in the greateſt perfection. Few who are not accuſtomed to the arts of culture, can imagine the advantage of this method: I had the good fortune to ſee it two years ago in a very remarkable manner in the caſe of the common mothmullien in a garden near *London*.

THIS is a wild plant in ſome parts of England, and produces under the hedges a long ſpike of handſome yellow flowers; but in the way I ſaw it raiſed, it exceeded in beauty all the kinds we bring from abroad. Nature ſows this plant in autumn, and it flowers the ſucceeding ſummer: the flowers ripen in July, and the ſeeds in Auguſt: theſe falling out as ſoon as the huſks are dry, ſow themſelves in September, and the young plants appear in October, which flower the following July. Here is only a growth of nine months, from the firſt ſhoot to the flowering. But according to the method here propoſed, we give the garden plants of the ſame kind eighteen months; this is twice the time: the root has twice the ſtrength, and the plant flowers with double beauty. The gentleman in whoſe garden I ſaw this plant in the ſummer

of

of the year 1756, ſowed it in the ſpring of 1755; the ſeeds were gathered from a wild plant the autumn before: they were ſown in March, tranſplanted in May, and removed into the flower-garden about the middle of June; they flowered the July of the ſucceeding year. The flowers were as big as a crown-piece, and of a yellow that exceeded the ranunculus. Every body admired the plant till they heard it was an Engliſh weed: and probably the ſeeds of theſe fine plants will raiſe a yet more beautiful progeny.

SECTION III.

The Culture by SUCKERS, LAYERS, *and* CUTTINGS.

NOTHING could be more natural than that part of gardening which multiplies flowering ſhrubs by the ſuckers that riſe near their roots: nature indeed makes the increaſe unaſſiſted; the gardener only removes the new plant to another place. This was the firſt way of propagation introduced into our Shrubberies; and from this came the other two. Where ſhrubs did not afford ſuckers, it was natural to try whether a branch buried in part in the ground, would not take root in time; and ſerve as a ſucker: This was tried, and it ſucceeded; and thus came in the method by layers. Long after this Lauremberg propoſed the way by cuttings. People thought him mad for ſaying a piece of twig ſtuck into the ground would grow; but they found it true on trial; and it is by far the

the moſt uſeful method of all. As it is not univerſal, the others muſt on ſome occaſions be ſtill employed. We ſhall therefore propoſe them in their natural order.

CHAP. I.

Of Propagation by SUCKERS.

MANY of our flowering ſhrubs, and other kinds, ſend out a number of young ſhoots from the root, which would make, as it were, a little thicket about them. Theſe are a deformity to the original tree, and they ſuck in that nouriſhment which ſhould go to feed its flowers and foliage. Therefore they ought to be cleared away, though they were not wanted: but they are every one capable of growing into a new ſhrub.

THE beſt time of propagating ſhrubs this way, is the middle of October. Suppoſe there is an old lilac in the garden, and that it is ſurrounded, as is naturally the caſe, with ſuckers, in October dig up a ſmall piece of ground in the nurſery, and open with a ſpade large holes at two foot diſtance every way, laying up the mould at the ſide of each hole. Then in the evening of a mild day take up all the ſuckers from the old plant, and chuſe as many of the fineſt as are deſired to be raiſed. The beſt are thoſe which are ſtraiteſt and thickeſt in proportion to their heighth; and ſuch as have grown fartheſt from the ſtem of the tree: cut off the ends of the roots, and plant one in every hole, firſt throw-

ing in a little of the loofe mould from the fide to make a good bottom. Drive in a fence-ftake pretty clofe to each, and let it ftand a foot and half out of the ground. Plant the fucker juft as deep as it was naturally where it rofe from the old root, and tie it to the ftake in two places with fome foft matting.

Thus plant the whole number intended, and then give them all a thorough watering. Repeat this every other day for a week, and they may then be left to nature. They will ftrike root during the remainder of the autumn, and will be found full of life in the following fpring. All the care they will require farther is, to keep the ground weeded between them, and in very dry feafons to give them fome water. They fhould ftand three years in this bed, and they will then be fit to plant in the garden. To this purpofe they muft be taken up at the fame feafon, that is, late in autumn; the fibres trimmed all about the roots, and in planting the mould muft be well fettled round them by careful laying in, and by a good watering. A ftake fhould be alfo thruft into the ground to tie them up; and if the weather be fevere, the firft winter fome dry peas-ftraw fhould be laid about the roots; and kept down by pegs. This is the whole culture by fuckers; and thus very fine plants may be obtained from many kinds of our fhrubs; but not from all: therefore other methods are alfo neceffary.

CHAP. II.

Of propagating SHRUBS *by* LAYERS.

WHEN ſhrubs do not yield ſuckers, and will not take by cuttings, recourſe muſt be had to laying. This may either be done from the branches of thoſe ſhrubs which are kept for flowering, or from ſuch as are planted for that purpoſe only; and are called ſtools.

THIS latter is the practice of nurſeries where great numbers are to be raiſed for ſale: the other is more the purpoſe in a gentleman's garden.

THERE are two ſeaſons for this work, the beginning of autumn, and early in the ſpring: the firſt is beſt for hardy trees, and particularly for thoſe which hold their leaves all winter; the latter for the generality of the other kinds.

IF the gardener has any of the more elegant flowering ſhrubs, which he intends to increaſe, the beſt method is by layers: and it ſhould be done in this manner. Chuſe out ſome of the branches which grow near the ground, or ſuch as can be bent down to it with the leaſt violence; and which have ſuch a length that they can bear to be in part buried five or ſix inches deep, and have a piece of half a foot in length left above the ground at the end. Draw theſe down in the manner they will come moſt naturally to the ground, and make a mark along the part at which each lies; mark alſo the part of the branch that will be under ground in the

laying.

laying. Then open as many trenches as there are branches to be laid, carrying them ſtraight along where the marks were made; and opening each a full ſpade deep: let the mould be very rich; and well broke in the working Let the trench be five inches deep all the way. Give each branch a ſlight twiſt in the middle of the place where it is to be under the mould. This muſt be done in ſo careful a manner, as juſt to crack the rind, and no more. Then with a ſharp penknife ſlit the branch thro' in the ſame place for an inch and half in length. Cut ſome hooked pegs to keep it down. Bring down each branch in a careful manner till it touches the bottom of the trench opened for it; and peg it *faſt* in that place with one, two, or more of the pegs, according to the danger there is of its getting up by the ſpring of the wood: then cover in the mould, preſſing it moderately cloſe about the branch with the hand; and to finiſh all give it a gentle watering. The next day water it ſomewhat more largely; and after this give it only the common care of the other plants. The end of the layer that is left out of the ground, will ſhew whether it continues in health; and all that is required more, is keeping the place well covered with mould; and in the dry time of the ſucceeding ſummer watering the ground at times: in the winter there will be very little need of this.

One year will ſerve in general for the giving them good roots. If the branches have been laid in autumn, they may be taken off from the old

tree the autumn following; and planted in a nursery-bed if they be slow growers; or if not, they may be at once set in the garden where they are to remain. Roses laid one autumn, and the layers taken up the next, will flower the succeeding summer; and so it is in many other kinds: but according to their natural flower growth others require more time.

If layers be desired from some curious shrub which has no branches near the ground, the method is this: Fix upon one or more of the branches for laying, and by pulling them gently down with the hand, observe how far they will naturally yield; then set up a tressel under each branch, and place upon it a trough of wood a foot deep, filled with very fine mould. Let the tressel raise this so high, that the branch can easily be brought down to it; and raise as many of these as there are branches intended to be laid. Then twist and slit every branch as before directed; and lay it down in the trough so that it may be covered five inches with mould, and leave a piece of a foot long standing out. Fasten this down with sticks thrust across the trough, and cover the branch with mould.

This must be watered more regularly and carefully than layers in the open ground, because the small quantity of mould in the box would otherwise quickly dry. The success of the whole depends upon keeping the earth moist: if it should be suffered to grow dry, even after the layer had shot roots, they would wither. If the care of watering be observed regularly, these

layers

layers will ſucceed as well as thoſe in the common ground; and at the end of one year they may be cut off from the old ſhrub, and planted in pots, or in the open ground, according to their kinds. This method extends the propagation by layers to almoſt all kinds of ſhrubs and trees; and when it is well managed, it will always ſucceed.

CHAP. III.

The Method of propagating by CUTTINGS.

THE benefit of the method by layers is very plain; but the operation is tedious and troubleſome. This has introduced the ſhort and eaſy practice of raiſing ſhrubs from cuttings: and wherever it will ſucceed, it is greatly preferable to that by layers; becauſe leſs time and trouble are required, and a much greater number may be raiſed this way than can the other.

NOT only ſhrubs and trees, but all plants which have woody ſtalks, may be propagated by this method. It may be done almoſt at any ſeaſon of the year; but the beſt time is in May and June, that the cuttings may take root ſo as to be fit for removing before winter. There are few kinds which, being managed with care, will not ſucceed in this manner. All cuttings require ſhade and water; and the more tender they are, the more perfectly they muſt be ſheltered. For the common kinds a ſmall bed in the nurſery, hooped over and covered with canvas, will anſwer very well. The more delicate will require to be covered with hand-glaſſes, or

to have the aſſiſtance of a hot-bed. Thoſe which will not ſtrike by one of theſe ways, uſually will by another; and there are very few that will not one way or other ſucceed.

IN the middle of June let a piece of the nurſery ground be dug up very well, and make a bed of three foot broad, and of ſuch length as may hold the proper number of plants: have ſome hoops ready to place over the bed, and a piece of canvas to cover them: it muſt be ſo large as to cover the hoops entirely, and to fall over to the ground at each end. Then take cuttings from all the ſhrubs and plants intended to be propagated, in this manner: Chuſe the ſtraiteſt, eveneſt, and moſt vigorous young ſhoots of the ſeveral kinds, and cut them off about ſeven inches long. Clip off the leaves from the lower part of each, and twiſt the bottom of the ſhoot: then with a fine awl pierce the bottom of the ſtalk thro' in ſeveral places up to an inch and half in height.

PLANT theſe two inches and an half deep in the mould of the bed, at a ſmall diſtance from one another; and continue till the whole number intended are in the ground; cloſe the mould very well about them, and give them a good watering. Plant the hoops over the bed, and lay the canvas upon them; covering them entirely: thus let them ſtand the firſt night. In the morning lift up the canvas at one end, and along the ſides, a little way from the ground; and keep it raiſed by bricks or pegs, that the plants may have ſome air but no ſun. In the evening

lift

lift off the canvas, and give them another watering.

This practice is to be continued; only giving them more and more air from time to time, till they have taken root. The mould must never be suffered to dry about them, nor must they be exposed to the sun; but the more air they have, after some days, the better. In this manner they will take root in six, eight, or ten weeks, according to their kinds: and then the greatest hazard is over: but they must still be shaded from the sun in the middle of the day, and watered frequently. In the beginning of September they must be transplanted, and they must then be removed according to their different degrees of tenderness or hardiness, into pots, or at once into the open ground: or by a milder course into warm nursery-beds that will raise them to more strength. It will be best to begin with the most tender. These must be potted: and for this purpose as many small pots must be prepared as there are of those plants, and filled with mould. The cuttings must be taken up one by one, and great care must be taken to take up a good ball of earth with each. They must be planted upright, one in each pot; the mould must be carefully closed about them, and they must be set in a warm sheltered place, and shaded from the sun by a canvas, or other contrivance. Here they must stand the winter; and as spring advances, they must be taken out of these pots, with the whole ball of earth, and planted in larger. The method is this: Have a

set

ſet of larger pots ready, with a heap of good mould; put a little of the mould into the bottom of one of the pots, and ſhake out the whole ball of earth in one of the ſmall pots; trim the fibres round the ſurface, ſet the ball upright in the larger pot, and fill in the reſt with more of the mould. Change the pots of all the plants in this manner, and ſet them in the ſame place: ſhade them from the ſun in the middle of the day, and water them conſtantly every evening. After this they will be ſoon eſtabliſhed into good healthy plants.

THIS is the whole management of the tender kinds, which are kept in pots always, as Geraniums, and the like. A ſecond ſort are ſuch as require ſhelter while young, but will bear the open air when grown up to ſome ſtrength. Of this kind are the Ciſtus, called the Rock-roſe, and the like. Theſe ſhould next be taken out of the bed, and they muſt be managed juſt as the former ſet; only that in the ſucceeding ſpring, when the others are put into larger pots to be kept for good; theſe are to be planted out into the borders. They muſt be taken out of the pots with the entire ball of earth, and planted upright with care; faſtening the ſtem to a ſmall ſtake thruſt into the ground to keep it ſteady. They muſt be well watered till they have taken root, and they will then need no more care, but will grow up into good ſhrubs.

THE third kind, which are hardier than theſe, but not abſolutely ſuited to our ſoil as natives, ſhould be next taken up and removed into a

nurſery-

nurſery-bed. Of this kind may be reckoned the hardy ſhrub St. Peter's-wort, and ſome others. When the plants of the two former claſſes are removed out of the firſt bed, a place muſt be prepared for theſe: they need not have pots; but only require a good ſpot of open ground. Look out a ſhady and perfectly well ſheltered part of the nurſery, and dig up a bed a full ſpade deep, breaking the mould very fine. Open holes in this at five inches diſtance every way; then take up the plants each with a ball to its root: place one in every hole; and keep them perfectly well watered till they are eſtabliſhed in the new ground: then leave them to nature. Only if the winter ſhould prove extremely ſevere, ſhelter them a little in the worſt weather.

In ſpring take them up with large balls of earth to the roots, and plant them in the garden in the places where they are to remain, watering them conſtantly till they are new rooted.

Last of all take up the plants of the fourth or hardieſt kind, and plant them at once in the borders. The Althæa Frutex, and ſome others, are of this kind. Let holes be opened in the borders where they are to ſtand; take them up one by one with good balls to the roots, and plant them in theſe openings: water them every day till they have taken root, and they will ſucceed without farther care.

Here is a plain and eaſy method by which a garden may be ſtocked with all the kinds of flowering ſhrubs almoſt without expence. Cuttings

tings may be had from any garden; and one bed raiſes them all: they are all to be tranſplanted from thence at one time; and the ſame method of culture afterwards raiſes them to perfection. Thus eaſy is gardening when the principles are once perfectly underſtood.

SECTION IV.

The Culture of the choiceſt FLOWERS.

LAST of all we are come to the management of the moſt elegant productions of the gardener's art: Theſe depend for their excellency upon the ſame principles of culture, tho' more time and care are required in raiſing them; than the other kinds: And it has appeared moſt proper to treat of them laſt, becauſe they will beſt be underſtood after the others.

THE common gardener is content to raiſe theſe flowers from off-ſets, or from parted roots; but this deprives him of all poſſible means of improvement. There requires time in the raiſing them from ſeed: but the trouble is very little; and this is the way by which new kinds are obtained. We propoſe taking off a great deal of the trouble of gardening, and yet directing the reader to the full knowledge of the art. We ſhall therefore give the plain method of raiſing theſe elegant kinds from ſeed, and bringing them to their higheſt perfection: and this method is ſo far the ſame for all the ſeveral kinds, that one care, and one

piece

piece of ground, may ſervé for the whole collection.

The flowers of this kind may be reduced into two claſſes; 1. the fibrous, or tuberous; and 2. the bulbous rooted. The firſt kind comprehends Auricula's, Ranunculus's, Anemones, and the like: the latter Tulips, Hyacinths, and thoſe others which have graſſy leaves. The culture of each of theſe flowers is delivered ſeparate by thoſe who have written on this ſubject hitherto; and a different kind of mould is directed for the reception of each ſeed; but I have found that one kind of earth ſerves them all, and one method of culture.

CHAP. I.

Of ſowing choice Flowers.

PREPARE the mould for theſe flowers thus. Pare off the turff in a dry piece of rich paſture ground, and dig up the mould as deep as it goes; this is uſually one full ſpade's depth: take care to go no deeper, and not to mix any of the bottom with it. In the beginning of March dig up five loads of this; mix with it three loads of river mud, one load of old cow-dung, and the ſame quantity of rotten mould dug up where an old faggot-pile has ſtood. Sprinkle over this four buſhels of ſlacked lime, and a pale-full of brine made of a peck of ſalt.

The quantity may be larger or ſmaller, according to the number of plants intended to be raiſed; but this is the beſt proportion: let it be all well work'd together, and thrown thro' a coarſe ſkreen; and thus let it lie till May: then turn it very thoroughly again: it will alſo require another turning in July; and this will compleat it for ſervice.

PROCURE ſeeds from ſome perſon on whom you can depend; they muſt be ſaved from the fineſt flowers that ripen any, for ſome of the very fineſt do not; and laid carefully to harden. Each parcel muſt be put up ſeparate, and laid by till the latter end of July.

THEN chuſe a part of the nurſery which is open to the ſouth-eaſt, and ſkreened from all other quarters: dig away the mould, make up beds with that which has been all this time preparing for that purpoſe, and mark them number 1, 2, 3, and ſo on. Each muſt be a yard wide, four inches deep in mould, and laid a little rounded. When theſe are all ready begin ſowing. Rake off an inch of mould from the ſurface of the firſt bed; mix ſome of it with the ſeed intended to be ſowed, and ſcatter it on evenly in the evening of a mild day. From the ſeventh to the ſeventeenth of Auguſt is the beſt period for this ſervice. Sift on as much of the mould that was raked off, as will cover the ſeeds a third part of an inch, and lay a piece of thorn-buſh upon the bed. Thus far it is the ſame with the method of raiſing the common perennial plants. It was before obſerved, that

that the difference is only in point of time and care. Sow every ſeed in this manner, and finiſh all the beds.

The ſeeds of theſe choice flowers are uſually ſown in pots and boxes; and the common writers on gardening give that direction. I have tried both, and find the open ground is beſt. The earth drys too faſt in theſe ſmall parcels; and the ſeeds grow better when they have the vapours from the open ground.

Once in three days water the beds in this manner: Lift off the buſhes, and lay a piece of old matting over the bed. Water upon this lightly and carefully, and when the wet has got through lift it off, and ſo water the next. The ground will thus be moiſtened without diſturbing the ſeeds. If gentle ſhowers fall naturally, theſe waterings may be omitted; but if heavy rains come on, ſome mats or cloths muſt be laid over the beds upon the thorn-buſhes, to keep off the violent force of the drops.

A very ſmall piece of ground will anſwer for this, and therefore the care is eaſy. Writers direct a different time for ſowing the ſeveral kinds, but this ſeaſon with this method ſuits them all.

The young plants will appear at various times, but the dangers to which they are expoſed are the ſame, and one kind of protection is required for them. No weed muſt be ſuffered to grow upon any of the beds. When the plants riſe very cloſe, ſome may be pulled up and planted in a more vacant place. When

rains fall heavy, mats muſt be laid over the thorn-buſhes; and as the froſts come on, the ſame care muſt be uſed to guard againſt them. In ſevere weather the beds muſt be kept covered up entirely; but when it is milder, they muſt have the free air of the middle of the day. Towards ſpring a reed-hedge muſt be ſet up to the north-eaſt of the beds to keep off the nipping winds from that quarter. Thus they will be kept till the beginning of the ſpring; and they muſt then be gently watered at times; and if the noon-day ſun appear to have too much power, they muſt be ſhaded from it.

Thus all the kinds will be kept in good condition till about June the next year; and at that time the Auricula's and Polyanthus's which retain their leaves, muſt be tranſplanted. Another bed like the firſt muſt be prepared for them, and they muſt be ſet at four inches diſtance one from another. They muſt be watered carefully, and ſhaded till they have taken root. After this no more is required than to keep the ground clear from weeds; and thus they will be gathering ſtrength till the next year.

These being removed, the other beds muſt be examined. The leaves of the young Anemones, and the reſt, will now be decayed; they muſt be clipp'd off, and the ſurface of the bed laid ſmooth, and a little of the ſame mould ſifted over the whole: about a third of an inch in thickneſs. Thus they muſt remain till autumn, keeping the ſurface clear from weeds. At

the beginning of October ſift another new coat of mould over them, of the ſame thickneſs with the former, and take the ſame care of the beds this as the former winter: only as the plants are ſtronger, it need not be ſo ſtrict. The plants which have been removed into the nurſery-beds muſt alſo be ſheltered during ſevere weather in the depth of winter, and the ſurface of all the beds muſt be kept clean from moſs.

THUS far the culture of all theſe plants is the ſame; but as ſome of them are afterwards to be taken up at certain ſeaſons, and treated in a manner different from thoſe whoſe leaves remain all the year, it will be proper to conſider their management in the reſt of their growth, under the three diſtinct heads of the fibrous, tuberous rooted, and bulbous plants: for according to this diſtinction of the roots, the management of them varies in the ſucceeding time.

CHAP. II.

The Management of FIBROUS-ROOTED *choice* FLOWERS.

OF this kind are the Auricula and Polyanthous Primroſe, with the like: the root conſiſts of fibres, and therefore does not admit of being kept any time out of the ground. On this depends the particular management of theſe plants.

THE raiſing all the kinds from ſeed being alike, that has been directed already. What

we here call their farther management, regards their flowering. The Auricula being the moſt excellent of theſe, its culture may ſerve as a direction for all the reſt: the principal difference between this and the Polyanthus, is, that the Auricula is kept in a pot, and the other in the open ground.

THE Auricula ſeed has been ſown in Auguſt, the young plants have been removed in the June following, and are now, we ſuppoſe, in the nurſery-bed into which they were ſet at that time. They are to remain there till the following ſpring, and the greater part of them will then flower. They will not blow fine, becauſe they ſtand cloſe; but it will be eaſy to ſee which will make another year the beſt flowers.

THE plants, in this nurſery-bed, may now be diſtinguiſhed into three kinds; 1. Thoſe which have good flowers; 2. Thoſe which have ordinary and indifferent ones; and, 3. Thoſe which yet ſhew no bloom. Many of theſe laſt will prove the fineſt of all. Mark the ſeveral ſorts with three kinds of ſticks, and thus let the bed remain till the middle of July; then manage the plants according to their value. Firſt take up all thoſe which have borne ordinary flowers, and plant them out in the borders of the garden. Then prepare as many pots as there are plants which have borne fine flowers, and take theſe plants up carefully with a ball of their own earth: plant them in pots of the ſame mould, and give them a gentle watering. The

plants

plants which have not yet flowered, may now be left in the bed without removing: they will ſtand the more free and clear for this taking away of the others; and they will gather great ſtrength the ſucceeding ſpring.

THE beds muſt be kept clear from weeds, and the mould ſometimes broke between the plants: if the autumn prove very dry, they muſt at times be watered; and a mat may be drawn over them in the ſeverity of winter.

THE plants in the borders require only the common care of every thing elſe that is in the ſame place; but thoſe which are potted muſt be managed more delicately. Set the pots under the ſhelter of a wall, or building defended from the north; and let there be a ſhed carried over them to keep off rain and too much ſun. Here let them ſtand all winter. In the middle of February bring in a quantity of the ſame mould, pare off the ſurface of the earth in all the pots an inch deep, and fill up the place with this, giving them now and then gentle waterings. If the froſt be ſevere after this, there muſt be a canvas drawn from the edge of the ſhed to the ground, in front and at both ends. This muſt be let down in an evening, and taken up two hours after ſun-riſe.

THUS they will be preſerved in the bud, and they will flower in perfection. When they blow they ſhould be removed to a ſtage of ſhelves one above another, and open to the ſouth-eaſt.

SOME

Some will now appear leſs valuable than was expected; and let theſe be put into the borders of the garden. Others will be much finer: Theſe laſt muſt be marked for increaſe. Seed muſt be ſaved from them for another ſowing; and the off-ſets carefully removed and planted in other pots, where they will make ſo many good plants. The time for taking theſe off is the beginning of April; and they muſt be managed juſt as the others.

The roots left in the nurſery-bed will now flower, and the beſt muſt be marked. Theſe muſt be put into pots the July following, and the others planted in the borders of the garden. This is the whole culture of the Auricula: and thus all the fibrous-rooted choice flowers are to be propagated.

CHAP. III.

The Management of Tuberous-rooted Flowers.

The Anemone, Ranunculus, and ſome other kinds, have roots of a thick ſolid ſubſtance, and irregular ſhape, nouriſhed by fibres. Theſe are called tuberous roots. They contain the rudiment of the plant which is to flower the next year; and they have ſo much ſubſtance to defend it, that they may be ſafely taken up after the flowering ſeaſon in ſpring; and kept in a dry place till autumn. This gives an

an advantage to the flowers; and on this depends their particular management.

WE ſhall here take the Anemone for an inſtance. The ſeeds were ſown in Auguſt with the others; the young plants took their growth together the firſt ſpring, and they have been refreſhed and ſheltered by a new coat of mould in ſummer, and by a ſecond in autumn. There we left them, and we are now to purſue their particular management. They muſt have ſome ſhelter if the winter be ſevere, and in ſpring they will ſhew themſelves above ground in larger and much ſtronger leaves than the firſt.

DEFEND them well from the north and eaſt; give them gentle waterings, and many of them will flower. Mark the roots into three kinds, as the Auricula's: 1. Thoſe which promiſe fine flowers; 2. Thoſe which ſeem indifferent; and, 3. Thoſe which have not flowered.

WHEN the bloom is over, the leaves will ſoon decay. Toward the end of May they will be in a manner gone: then look over the bed, firſt taking up thoſe roots which were marked for fine flowers: clip off the remains of the ſtalk and leaves, and waſh off the mould, and ſpread them upon a piece of canvas ſtretched above the ground in an airy room, where there is no ſun.

NEXT take up the roots of the more indifferent flowers, and clean and dry them in the ſame manner. When they are very dry, put them up in ſeparate parcels, and keep them ſafe till autumn.

Leave thoſe roots in the firſt bed which have not yet flowered.

In the middle of September make up two beds of the ſame mould, raiſe them five inches above the ſurface, and round them at the top. When the mould las lain a week to ſettle, dig it up again, level the ſurface as before, and plant the roots; the fine ones in one of theſe beds, and thoſe of an inferior kind in the other. Plant the roots two inches deep, opening the ſurface for this purpoſe with the point of a trowel; and cover them carefully with the mould. They ſhould ſtand at five inches diſtance one from another.

If the winter ſhould be very ſevere, the beds muſt be ſheltered in the worſt weather. In ſpring yet more care is needed, for theſe roots, being planted early, will ſoon ſhoot for flower; and nothing is ſo injurious as froſt, or ſharp winds to the bud. There muſt be hoops placed over the beds, and canvaſſes drawn over them in the bad weather. They muſt now and then have the benefit of watering, and always be open to the noon-day ſun, which at this early ſeaſon will have no power to hurt them. They muſt only be covered in bad weather, for the more air they can have ſafely, the better they will blow.

It will be now ſeen which are the fineſt flowers, for there is no certainty in the firſt blowing: not that the fineſt of the former year will grow worſe, but many of the ſecond bed will ſhew themſelves much better than they promiſed.

promifed. No Anemone has its full ftrength till the fecond year's bloom, and no judgment can be formed of it till that time with certainty.

THE roots left in the feed-bed will this year alfo flower ; and they muft be marked by two kinds of fticks ; and afterwards taken up and managed as the others.

THIS is the whole culture of the Anemone. Every fummer the roots are to be taken up and dried, and every autumn planted. They will increafe ; and the feparated parts may be raifed to flower like the off fets of Auricula's, or other plants : and thus there will be a continual enlargement of the quantity. But the way to raife new and fine kinds muft be by fowing. Therefore as double Anemones do not ripen feed, it muft be faved from the fingle ones ; many of thefe appear with the double ; and fome of the beft plants muft be preferved for this purpofe. The trouble of fowing is fo little, that it may very well be repeated every year.

CHAP. IV.

The Management of BULBOUS-ROOTED FLOWERS.

THESE have a large roundifh root ; compofed of a folid flefhy fubftance, or of many fkins one over another. The rudiment of the future plant is preferved fo well in thefe,

 that

that they may, as the tuberous ones, be taken up after flowering, and kept out of the ground till autumn. This is of the ſame advantage to the flowers as in the other inſtance; and the management is in a great meaſure the ſame; only the ſeedling plants are much longer before they flower. This makes the practice ſomewhat different. We ſhall ſelect the Tulip for an inſtance.

As we directed all the ſeeds to be ſown at the ſame time in ſeparate beds in the nurſery, we are to ſuppoſe Tulip-ſeed had its place among the reſt. Theſe ſeeds have been ſown in Auguſt. The young plants will appear the following April like blades of graſs; and theſe firſt leaves will fade in about five weeks. The ſurface of the bed ſhould be then cleared of all young ſhoots of weeds or moſs, and ſome freſh mould ſifted on to cover it a third of an inch. In September the ſurface muſt be again well cleared of every foulneſs, and a new coat of the ſame mould ſifted on of the ſame thickneſs. All this time, and all the following winter, the minute roots will be gathering ſtrength. In ſpring they will again ſhoot up ſmall leaves: theſe will fade as the heat of ſummer comes on, and then the roots are to be taken up. This muſt be done with care, for they are yet very ſmall.

A new bed muſt be made for them, and this ſhould be five inches thick in mould: the bottom ſhould be the natural earth, well rammed, that it may be even and hard: the

roots

roots muſt be planted in this bed when they are taken out of the other, which will be about the beginning of July. They muſt be ſet at three inches diſtance, and covered an inch and half above the crown. At the latter end of September, a freſh covering of half an inch of the ſame mould muſt be given them, and the ſame early in the ſpring. After this the bed muſt be watered at times; the leaves will appear again in March, and fade about July: then a freſh coat of half an inch of mould muſt be laid on, and the ſame again in autumn. The next ſummer they muſt have juſt the ſame management; and in the ſummer of the ſucceeding year they muſt be taken up again.

THE roots having now four years growth, will be of ſome conſiderable ſize. A new bed muſt then be made for them juſt as the former, only two inches deeper in mould. They muſt be planted in this three inches deep from the crown to the ſurface, and they muſt ſtand ſix inches aſunder.

THEY muſt remain two years in this bed, keeping the ſurface conſtantly clear from weeds, and giving them a new coat of mould every ſummer and autumn. This brings them to their perfection, and the next year they will flower. Some will blow ſooner, but they will be the worſe for it.

The roots muſt be taken up in the ſummer of this laſt year, and laid on a canvas to dry. They ſhould be kept out of the ground till autumn,

autumn, and then planted in beds of the ſame mould two foot deep, and rounded at the top: the roots muſt be planted ſeven inches deep, and ten inches diſtant from one another. The next year they will blow in perfection as to ſhape and bigneſs; but they will not come to the beauty of their colours till after one or more years of farther growth.

EVERY ſeaſon the roots muſt be managed as already directed; and in every ſummer's blowing there will be ſome ſeen broken into ſtripes. Theſe muſt be marked when in flower, and the roots ſeparated from the others when they are taken up: they muſt be planted in particular beds; and they will make by degrees a fine collection.

THIS is the culture of the Tulip, the *moſt* delicate of all the bulbous roots: and thus that flower will be brought to its higheſt perfection. The time of its growth is long; but the trouble is very little.

FINIS.